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Operational Groundwater Monitoring at the Hanford Site--1988

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and in the 200 Areas, 216-A-37-1 Crib, 216-A-45 Crib, 200 East and 200 West Area low-level burial grounds, 216-S-25 Crib, 216-U-17 Crib, and 216-W-LWC Crib. The other constituents were measured above the control standards in the groundwater at the following active facilities.

- 1324-N/NA Pond. Sulfate and, consequently, specific conductance have been above control standards since monitoring for these parameters began in 1987.

- 216-A-37-1 Crib. Tritium concentrations have been fluctuating and in one monitoring well have periodically exceeded the DCG.

- 216-A-45 Crib. Tritium concentrations remain above the DCG but have been declining since before the crib began operating in 1987.

- Grout Treatment Facility. Chromium concentrations were above control standards but are decreasing; the cause may be inadequate well development.

- 216-U-17 Crib. Uranium, ^{99}Tc, and specific-conductance levels are above control standards and still increasing in some wells; contaminants were present and increasing before crib was activated in 1988.

- Low-Level Burial Grounds (200 West Area). Chromium concentrations are above the control standard but may reflect inadequate well development.

- 300 Area Process Trenches. Uranium is above control standards at a number of wells close to the trenches.

Significant inactive sources of groundwater contamination include the following inactive facilities.

- 183-H Solar Evaporation Basins. Elevated levels of chromium and uranium in the groundwater result from a 1977 storage basin leak.

- 1301-N Waste Disposal Facility. The highest ^{90}Sr readings on the Hanford Site are observed beneath this facility and current levels remain stable.

- 216-A-10 Crib. Tritium concentrations beneath the crib are still high but continue to decrease.

- BY Cribs. A plume containing elevated levels of ^{99}Tc, ^{60}Co, and cyanide from disposal activities during the 1950s is moving northward from the 200 East Area.

EXECUTIVE SUMMARY

The purpose of this document is to present an annual summary of results for calendar year 1988 of the Westinghouse Hanford Company Operational Groundwater Monitoring Network (OGWMN). The program described in this report supports the U.S. Department of Energy requirements to monitor radioactivity and hazardous chemicals in the environment at its production facilities.

Groundwater monitoring at the Hanford Site is implemented in three programs: the OGWMN, the Resource Conservation and Recovery Act (RCRA) compliance program, and the Pacific Northwest Laboratory (PNL) Hanford Site monitoring network. The scope of the OGWMN is the near-field (close to facility) monitoring of groundwater beneath active and inactive waste disposal facilities associated with Hanford Site operations. To achieve compliance with State and Federal regulations, monitoring of all the active and recently active disposal facilities will eventually be performed by the RCRA compliance program. The PNL Hanford Site monitoring network provides far-field and background monitoring across the Hanford Site. These three programs are coordinated to produce a comprehensive groundwater monitoring network for the entire Hanford Site.

Over 180 wells are sampled for the OGWMN, primarily in the 200 Areas. An additional 230 wells located near waste sites are sampled for the other two monitoring programs and are used to supplement OGWMN data in this report. Monitored waste disposal facilities are located in the 100, 200, 300, 400, and 1100 Areas of the Hanford Site.

Groundwater monitoring consists of water-level measurements used for the determination of hydraulic gradients and water quality sampling. Selected radionuclide analyses, including gross alpha, gross beta, tritium, ^{90}Sr, ^{99}Tc, and uranium are the most commonly analyzed parameters in the groundwater samples. Nitrate is also analyzed for in most wells. Increasingly, more comprehensive chemical analyses are being performed on the samples including analyses for the detection of a variety of hazardous chemicals. Samples are most commonly collected on a quarterly basis, though monthly and semiannual sampling also occurs.

Concentrations of groundwater parameters are compared with internally established control standards. These standards are generally based on drinking water standards or on meeting the drinking water standards at the point of public exposure. Internal concentration standards have not been established for tritium and many hazardous chemicals so the concentrations of these constituents are compared to the drinking water standards or, for tritium only, the derived concentration guide (DCG).

During 1988, the contaminant concentrations measured in the groundwater exceeded the control standards at a number of wells monitoring active and inactive waste disposal facilities. Constituents found at levels above the control standards in at least one active waste-site-monitoring well are nitrate, uranium, ^{99}Tc, chromium, sulfate, and specific conductance. Tritium concentrations in wells at two active disposal facilities exceeded the DCG. Nitrate, the most pervasive groundwater contaminant on the Hanford Site, was measured at levels above the control standard in wells at eight active waste disposal facilities: in the 100-N Area, the 1325-N Waste Disposal Facility,

LIST OF TERMS

CERCLA	Comprehensive Environmental Restoration, Compensation, and Liability Act
CY	calendar year
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
GTF	Grout Treatment Facility
LLBG	low-level burial ground
LWDF	Liquid Waste Disposal Facility
MCL	maximum contaminant levels
NRDW	Nonradioactive Dangerous Waste
OGWMN	Operational Groundwater Monitoring Network
PFP	Plutonium-Finishing Plant
PNL	Pacific Northwest Laboratory
PUREX	Plutonium Uranium Extraction (Plant)
RCRA	Resource Conservation and Recovery Act
SWL	Solid Waste Landfill
U.S. Testing	United States Testing Company
WDF	waste disposal facility
Westinghouse Hanford	Westinghouse Hanford Company

- 216-B-5 Reverse Well. Localized plutonium, ^{90}Sr, and ^{137}Cs contamination disposed directly to the groundwater in the late 1940s remains stationary.
- 216-A-25 (Gable Mountain) Pond. The ^{90}Sr plume detected beneath the pond site is not moving significantly.
- 216-U-1/2 Cribs. Uranium concentrations continue to decline following remedial activities performed in 1985.
- 216-Z Cribs. Carbon tetrachloride from disposal to cribs servicing the Plutonium Finishing Plant is found extensively in the groundwater beneath the central and northern parts of the 200 West Area.

Contamination plume maps constructed for gross beta, tritium, and nitrate beneath the 200 Areas show only slight changes from previous years.

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1.0 INTRODUCTION

Westinghouse Hanford Company (Westinghouse Hanford) is the operating contractor for the U.S. Department of Energy (DOE) Hanford Site. An important responsibility of the operating contractor is managing waste generated by past and present production processes [DOE Order 5480.1B (DOE 1986)]. One component of waste management at the Hanford Site is groundwater monitoring at waste disposal facilities, which is the topic of this report.

1.1 PURPOSE AND OBJECTIVES

The purpose of this annual report is to describe the Operational Groundwater Monitoring Network (OGWMN) and summarize the results generated during calendar year (CY) 1988. It supplements the annual environmental monitoring report (Elder et al. 1989) prepared by Westinghouse Hanford and continues the series of annual groundwater reports (e.g., Serkowski et al. 1988; Law, Serkowski, and Schatz 1987; Law and Schatz 1986) generated by the primary operating contractor over the past 13 yr. This year's report differs from past reports because it presents groundwater information for all operations-related facilities on the Hanford Site, instead of only those facilities located in the Separations Areas (200 East and 200 West Areas and vicinity). In addition, this report includes discussions of nonradiological constituents found in the groundwater instead of only radionuclides.

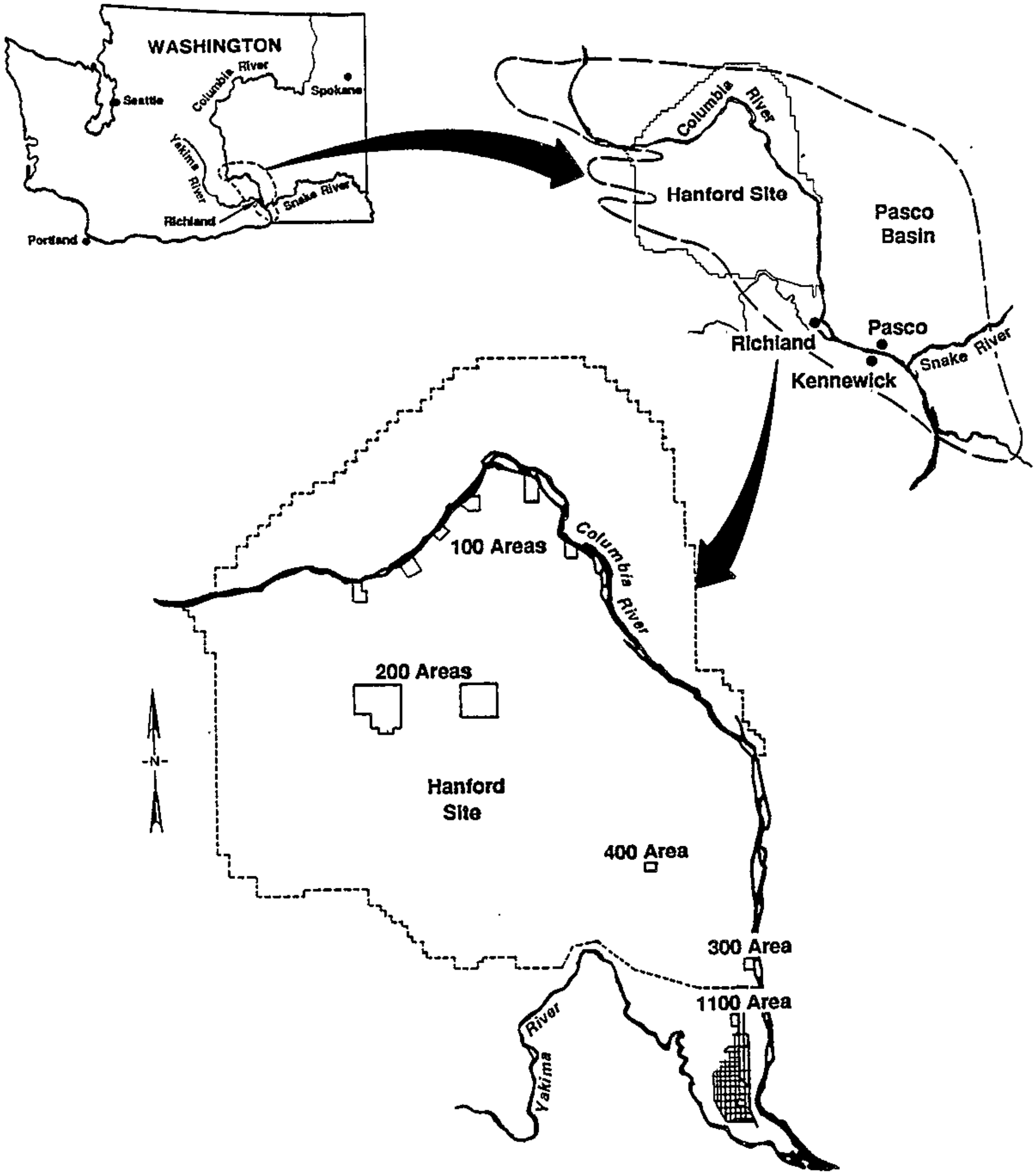
The objectives of this report are as follows:

- Provide the requirements applicable to groundwater monitoring beneath waste disposal sites
- Describe the operational groundwater monitoring program
- Present the results of the OGWMN and pertinent results from other Hanford groundwater monitoring programs
- Compare the analytical results with the applicable requirements.

1.2 SITE DESCRIPTION

The Hanford Site is located in south-central Washington State, approximately 170 mi (270 km) southeast of Seattle and 125 mi (200 km) southwest of Spokane (Figure 1). The Site was established by the United States government in 1943 to produce the plutonium used in the construction of nuclear weapons. Although this original mission continues today, the focus of operations is turning toward cleanup of wastes generated during the past 45 yr.

Figure 1. Hanford Site Location Map.



1.2.1 Operational Areas

Most of the production facilities at the approximately 560-mi^2 Hanford Site are concentrated in operational areas known as the 100, 200, 300, 400, and 1100 Areas. Facility waste discharged to the soil column is typically, though not always, disposed of within the area where it is generated. The region outside of the operational areas, known as the 600 Area, has received relatively minimal quantities of waste in the past. This report discusses only the near-field impact to the groundwater within the operational areas. Far-field impacts to the groundwater have also been observed and are reported in Evans et al. (1988).

1.2.1.1 100 Areas. The 100 Areas consist of eight inactive nuclear reactor areas that were used for plutonium production and the 100-N Area, which consists of the dual-purpose N Reactor. The N Reactor is currently in shutdown status. The reactors are located along the Columbia River in the northern part of the Hanford Site in six areas referred to as 100-B/C, 100-D, 100-F, 100-H, 100-K, and 100-N Areas. Only the 100-B/C, 100-D, and 100-N Areas contain processes that currently are discharging liquid effluent to the ground, though disposal or storage of contaminated liquids and solids have occurred at all of the 100 Areas.

1.2.1.2 200 Areas. The 200 Areas consist of the 200 East and 200 West Areas, which are located near the center of the Hanford Site. The 8 mi (13 km) by 10 mi (16 km) region encompassing the 200 Areas is known as the Separations Area. The 200 Areas contain active and inactive facilities for processing the irradiated fuel rods from reactors in the 100 Areas. The waste generated by these facilities comprises the vast majority of hazardous and radioactive material stored or disposed of at the Hanford Site. Plants that currently dispose of liquid waste to the ground include the Plutonium-Uranium Extraction (PUREX) Plant and B Plant in the 200 East Area and the Plutonium Finishing Plant (PFP) and UO_3 Plant in the 200 West Area. Waste management activities in the 200 Areas include disposal of low-level radioactive liquid effluent to the soil column, burial of low-level radioactive and mixed solid waste into trenches, and storage of high-level radioactive and mixed wastes in underground tanks. A fraction of the waste stored in the tanks will be processed through the Grout Treatment Facility (GTF) located in 200 East Area and disposed to the ground as solid grout slabs.

1.2.1.3 300 Area. The 300 Area was constructed as a fabrication facility for fuel rods used in the 100 Area nuclear reactors. The 300 Area is located near the southeastern corner of the Hanford Site along the Columbia River. Because fuel fabrication is no longer conducted in the 300 Area, liquid effluent that is discharged to the ground is primarily cooling water from various facilities and chemical sewer water from several laboratories.

1.2.1.4 400 Area. The 400 Area is the site of the Fast Flux Test Facility (FFTF), which is an experimental breeder reactor used for research purposes. The FFTF is located approximately 6 mi (9.6 km) northwest of the 300 Area in the southeastern part of the Hanford Site. Only small quantities of uncontaminated cooling and sump water are currently being discharged to the ground. Several deep wells located within the 400 Area supply drinking and sanitary water for use by the facilities and their personnel.

1.2.1.5 1100 Area. The 1100 Area includes Hanford Site maintenance and warehouse facilities. The site is located immediately north of Richland, Washington, at the southern boundary of the Hanford Site. Waste disposal to the soil column does not presently occur within the 1100 Area, though small quantities of hazardous chemicals generated by maintenance activities were disposed of to the ground in the past.

1.2.2 Waste Disposal Facilities

A waste disposal facility (WDF), for the purposes of this report, is a site that is or was used to routinely dispose of potentially hazardous or radioactive liquid or solid waste. This definition also includes permanent waste storage facilities such as the single- and double-shelled tanks used for high-level radioactive waste. Facilities used for disposal of sanitary water are not covered in this report.

A variety of disposal and storage facilities have been used at the Hanford Site. Low-level radioactive and hazardous solid waste, which includes contaminated equipment and clothing, is buried in shallow trenches.

Low-level radioactive liquid wastes, which include cooling water and process condensate, are disposed of to the ground and allowed to percolate through the near-surface sediments. Infiltration is accomplished by using ponds, ditches, and various underground dispersion systems such as cribs, and french drains. Most liquid WDFs were designed to permit sorption of the radioactive constituents by the sediments in the unsaturated zone above the water table. Disposal of liquid wastes to the ground has resulted in contamination of the unconfined aquifer at the Hanford Site. For this reason, liquid WDFs are a primary focus of groundwater monitoring activities.

High-level liquid and solid radioactive waste containing fission products from fuel processing operations are stored in underground single- and double-shelled tanks arranged in clusters known as tank farms. These wastes are isolated from the environment to await final disposition at a future date. However, leaks have developed in some of the single-shelled tanks (Thurman 1989) which could impact the groundwater in the future. The tank farms are monitored primarily through a network of vadose-zone wells, which are routinely logged with geophysical equipment for the presence of gamma-emitting radionuclides.

1.3 HYDROGEOLOGY

The Hanford Site is underlain by a thick unconfined aquifer contained in alluvial sediments and a series of confined aquifer systems isolated by a sequence of basalt flows. Because potential contaminants will encounter the uppermost aquifer before entering the lower aquifers, the emphasis in groundwater monitoring is on the unconfined aquifer. However, limited monitoring of the uppermost confined aquifer is also performed. A brief overview of the geology and hydrology of and contaminant transport in the unconfined aquifer is presented in the next paragraphs.

1.3.1 Geology

The Hanford Site is located within the Pasco Basin, which is a structural and topographic basin with boundaries defined by anticlinal structures of basalt (Gephart et al. 1979). Three main geologic units are located beneath most of the Hanford Site. In ascending order, these geologic units are the Columbia River Basalt Group, the Ringold Formation, and the glaciofluvial sediments, informally known as the Hanford formation. The Columbia River Basalt Group is a thick sequence of basalt flows extruded during the Miocene epoch. The Ringold Formation, a Pliocene fluvial sedimentary unit, overlies the Columbia River Basalt Group, except in areas where erosion has removed these sediments. The Ringold Formation is subdivided into four units (on the basis of texture), which are, in ascending order, the basal Ringold unit (sand and gravel), the Lower Ringold unit (clay, silt, and fine sand with lenses of gravel), the Middle Ringold unit (occasionally cemented sand and gravel), and the Upper Ringold unit (silt and fine sand). The Hanford formation was deposited on top of the Columbia River Basalt Group and Ringold Formation during the Pleistocene epoch. The Hanford formation consists of unconsolidated coarser sands and gravels overlain by finer-grained sands and silts.

The thickness of the Ringold and Hanford Formations varies across the site. Depth to the first basalt flow below operational areas ranges from less than 50 ft (15 m) around the decommissioned Gable Mountain Pond (216-A-25 Pond) north of the 200 East Area to over 600 ft (183 m) south of the 200 Areas. In general, depth to basalt is slightly greater than 300 ft (91 m) in the 100 Areas, between 300 and 500 ft (91 to 152 m) in the 200 Area, and around 200 ft (61 m) in the 300 Area.

1.3.2 Occurrence of Groundwater

Disposal of waste water to surface and subsurface disposal sites affects the groundwater of the unconfined aquifer. The depth to groundwater is dependent on topography and the extent of water-table mounding caused by waste-water disposal. The 200 Areas are located on an elevated plateau where the top of the aquifer lies from 180 to 340 ft (55 to 105 m) below the surface. North and east of this plateau the depth to groundwater decreases significantly from 125 ft (40 m) at B Pond to 25 ft (8 m) at the deactivated Gable Mountain Pond. Along the Columbia River, where the 100 Areas and the 300 Area are located, the depth to groundwater varies from about 60 ft (18.3 m) to about zero at the edge of the river.

The unconfined aquifer is contained within the Ringold Formation and the overlying Hanford formation. Beneath the unconfined aquifer is a confined aquifer system consisting of sedimentary interbeds or intraflow zones that occur between dense basalt flows or flow units. The bottom of the unconfined aquifer is the uppermost basalt surface or, in some areas, a clay zone of the Ringold Formation. The thickness of the unconfined aquifer in the 200 Areas varies from less than 50 ft (15 m) to over 230 ft (70 m). The unconfined aquifer is about 190 ft (57.9 m) thick in the 100-H Area, 80 to 90 ft (24.4 to 27.4 m) in the 100-N Area, and up to 100 ft (30.4 m) in the 300 Area.

The principle source of natural recharge to the unconfined aquifer is rainfall runoff from areas of high relief to the west of the Hanford Site, which feeds several ephemeral streams. From these recharge areas, the groundwater generally flows eastward and discharges into the Columbia River. In the 200 Areas, this flow pattern is modified by basalt outcrops and subcrops and by artificial recharge.

1.3.3 Aquifer Properties

Large differences in aquifer properties are evident between the Hanford formation and the middle member of the Ringold Formation, which are the major units of the unconfined aquifer. Hydraulic conductivities range from 10 to 230 ft/d (3 to 70 m/d) for the middle Ringold unit and from 2,000 to 10,000 ft/d (600 to 3,000 m/d) for the Hanford formation. Transmissivity increases from the 200 West Area to the 200 East Area. This transmissivity increase is a result of two factors: the saturated thickness of the aquifer is greater (the result of a drop in the basalt surface), and more of the unconfined aquifer is contained within the more permeable Hanford formation.

1.3.4 Contaminant Transport

Contaminants in the groundwater generally move in the direction of groundwater flow. The concentration of contaminants may be attenuated by factors within the geohydrologic system: sorption, dispersion, and dilution. For radiological constituents, the concentration is also reduced by radioactive decay which varies depending on the half-life of the radioisotope.

Sorption is the process by which contaminants are chemically bound to the surface of sediment particles. A measure of sorption is the distribution coefficient, K_d, which describes the partitioning of a solute between liquid and solid phases in the subsurface environment (Freeze and Cherry 1979). A small K_d value indicates that the solute moves with groundwater; that is, the solute would be very mobile. A large K_d value denotes that the solute is essentially immobile; that is, it would be sorbed on the sediment particles. For example, tritium and nitrates are considered mobile because neither is sorbed by the soil, while plutonium is readily adsorbed by sediments and is immobile. The distribution coefficient is a function of the ion involved, the mineralogy of the sediments, and the chemistry of the solution.

Dispersion is the process whereby groundwater contaminants are spread out along the flow path because sediment particles serve as obstacles to flow. Dispersion is primarily a mechanical process.

The process of dilution occurs when water containing contaminants mixes with cleaner water resulting in a decrease in contaminant concentration.

The concentration of radioactive contaminants in a plume is reduced over time by the natural decay of the radioisotopes. The half-life of a radioisotope is the time required for a quantity of radioactive material to decay to one-half of its activity. The concentration of a radioisotope will be reduced to 1% of the original concentration in less than seven half-lives.

The mechanisms of sorption, dispersion, dilution, and radioactive decay attenuate the concentrations of radionuclides disposed of to the sediments at the Hanford Site. Thus, concentrations of contaminants at any downgradient location are lower than the concentration at the nearest upgradient source.

1.4 GROUNDWATER MONITORING PROGRAMS

Three groundwater monitoring programs are being implemented concurrently at the Hanford Site. Each program fulfills a different need and together they provide comprehensive coverage of the groundwater beneath the Hanford Site. The following sections will discuss each of these groundwater monitoring programs.

1.4.1 Operational Groundwater Monitoring Network

The OGWMN is the subject of this report and is described in detail in Chapter 3.

1.4.2 Resource Conservation and Recovery Act Compliance Monitoring

Resource Conservation and Recovery Act (RCRA) compliance monitoring is a rapidly expanding program designed to satisfy the Washington State Department of Ecology (Ecology) and U.S. Environmental Protection Agency (EPA) requirements for WDFs. A typical RCRA monitoring project consists of a single WDF, e.g., a crib or pond, with a minimum of one upgradient and three downgradient groundwater monitoring wells. The wells are constructed and sampled in accordance with RCRA protocol (e.g., EPA 1986).

In 1988, Westinghouse Hanford maintained 13 RCRA compliance projects (Fruland and Lundgren 1989). Table 1 summarizes the WDFs covered by these projects and the number of wells associated with each. Status and results of the RCRA monitoring projects during 1988 were published by PNL in quarterly reports (e.g., Fruland, Bates, and Lundgren 1989) and summarized in an annual report (Fruland and Lundgren 1989).

The relationship between the OGWMN and the RCRA program is close because the RCRA projects also monitor near-field impacts on groundwater from operations-related facilities. Indeed, establishment of a RCRA project will usually displace the monitoring performed for the OGWMN to prevent duplication of effort. The role of the OGWMN, then, will be to fill the gap in the monitoring network until RCRA projects, and later, the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) investigations, can adequately monitor all facilities. To provide the best description of the groundwater beneath WDFs at the Hanford Site, available data from the RCRA program are used to supplement OGWMN data throughout this report.

Table 1. Resource Conservation and Recovery Act Groundwater Monitoring Projects at the Hanford Site in 1988.*

Resource Conservation and Recovery Act waste facility	Hanford Site area	Monitoring wells	Monitoring level
183-H Solar Evaporation Basins	100-H	23	Assessment[a]
1301-N LWDF	100-N	6	Background[b]
1324-N/NA LWDF	100-N	5	Background
1325-N LWDF	100-N	11	Background
Low-Level Burial Grounds	200 East/ 200 West	34	Background
2101-M Pond	200 East	4	Background
216-A-10 Crib	200 East	6	Background
216-A-29 Ditch	200 East	5	Background
216-A-36B Crib	200 East	8	Background
216-B-3 Pond	200 East	7	Background
Grout Treatment Facility	200 East	5/11[c]	Preoperational background
300 Area Process Trenches	300	27/34[d]	Assessment
Nonradioactive Dangerous Waste Landfill	600	7	Detection[e]
Solid Waste Landfill	600	7	Background

[a]Assessment level: characterization of detected contamination.
[b]Background level: collection of initial data at newly monitored facility.
[c]Five wells are monitored for compliance; six additional wells are monitored for characterization.
[d]Monitoring network was reduced from 34 wells to 27 wells in October 1988.
[e]Detection level: monitoring of contamination indicator parameters.
LWDF = Liquid Waste Disposal Facility.

*Source: Fruland and Lundgren 1989.

1.4.3 Pacific Northwest Laboratory Hanford Site Groundwater Monitoring Program

Pacific Northwest Laboratory (PNL) operates the Hanford Site groundwater monitoring program to provide far-field and background data on contaminants in the unconfined aquifer across the Hanford Site. This network, which extends to the boundaries of the Hanford Site, provides the data for calculating radiation exposure to the public from groundwater. The network consists of almost 400 groundwater wells in the 100 Area (35 wells), 200 Areas (90 wells), 300 Area (46 wells), 400 Area (6 wells), and 600 Area (217 wells) (Bisping 1989). Many of the wells are sampled for gross alpha, gross beta, tritium, nitrate, and several site-specific radionuclides on a semiannual or annual schedule. A number of these wells are also periodically sampled for a suite of hazardous chemical constituents. The results of the Hanford Site groundwater monitoring program are documented by PNL in a detailed semiannual report (e.g., Evans et al. 1988) and in a more general annual environmental report (e.g., Jaquish and Bryce 1989).

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2.0 REGULATORY REQUIREMENTS

The activities of Westinghouse Hanford as a DOE subcontractor must comply with established DOE Orders. The DOE Orders applicable to groundwater protection, monitoring, and reporting and their interpretation by Westinghouse Hanford are described below.

2.1 U.S. DEPARTMENT OF ENERGY ORDERS

The requirements applicable to environmental monitoring at the Hanford Site are broadly established in DOE Order 5480.1B, Environment, Safety, and Health Program for Department of Energy Operations (DOE 1986). However, the recently issued DOE Order 5400.1, General Environmental Protection Program, more specifically defines the requirements of a groundwater monitoring program (DOE 1988). The DOE Order 5400.1 requires that the groundwater must be in compliance not only with DOE requirements, but also with applicable Federal, State, and local laws and regulations. In particular, it states that the groundwater monitoring program shall be designed and implemented in accordance with RCRA regulations, as a minimum, where hazardous or potentially hazardous wastes are involved.

Because DOE Order 5400.1 (DOE 1988) was issued in late 1988, the new requirements were not implemented during 1988. A schedule for compliance with this order is in place. This report discusses the results of the OGWMN in terms of the new regulations, where possible.

Reporting requirements for environmental monitoring programs are presented in DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements (DOE 1981). The Order requires the preparation of an annual report describing the impact of operations on the environment, including the groundwater, and a calculation of the radiation dose received by the public as a result of this impact. This reporting requirement is met by PNL's annual environmental report (Jaquish and Bryce 1989).

2.2 WESTINGHOUSE HANFORD COMPANY REQUIREMENTS

Westinghouse Hanford has interpreted the DOE Orders referenced above to form a set of compliance requirements for the operation of WDFs. The requirements specify the maintenance of a groundwater monitoring network at each active WDF and establish standards for the quality of groundwater beneath the facility. If a WDF falls out of compliance with the standards a sequence of administrative actions is initiated to rectify the situation until compliance is reestablished.

2.2.1 Groundwater Standards

Groundwater quality standards, used by Westinghouse Hanford, are listed in Tables 2 and 3. The concentration levels were developed using established standards provided by DOE (for radionuclides) and Washington State (for nonradionuclides). Radionuclide standards are designed so that at the end

Table 2. Control Standards for Nonradioactive Groundwater Contaminants at the Hanford Site.

Constituent	Control standard	Units
Chlorinated Hydrocarbons		
Endrin	0.2	p/b
Lindane	4	p/b
Methoxychlor	100	p/b
Toxaphene	5	p/b
Chlorophenoxys		
2,4-D	100	p/b
2,4,5-TP Silvex	10	p/b
Trihalomethanes	100	p/b
Primary Contaminants		
Arsenic	50	p/b
Barium	1000	p/b
Cadmium	10	p/b
Chromium	50	p/b
Fluoride	2000	p/b
Lead	50	p/b
Mercury	2	p/b
Nitrate (as NO_3)	45,000	p/b
Selenium	10	p/b
Silver	50	p/b
Turbidity	1	p/b
Secondary Contaminants		
Chloride	250,000	p/b
Color	15	p/b
Copper	1000	p/b
Iron	300	p/b
Magnanese	50	p/b
Specific conductivity	700	umhos/cm
Sulfate	250,000	p/b
Total dissolved solids	500,000	p/b
Zinc	5000	p/b

Table 3. Control Standards for Radioactive Groundwater Contaminants at the Hanford Site.

Constituent	Control standards (pCi/L) 200 East Area	200 West Area	Outside 200 Areas
^{137}Cs	210	1200	120
^{60}Co	5000	5000	200
^{129}I	20	20	20
^{238}Pu	2.0	3.6	1.6
$^{239,240}Pu$	1.2	1.2	1.2
^{106}Ru	6000	6000	240
^{90}Sr	74	480	40
^{99}Tc	4000	4000	4000
^{234}U	20	20	20
$^{235,238}U$	24	24	24

NOTE: Tritium has no Westinghouse Hanford Company control standards for concentration (though total quantity released in the 200 Areas is limited to 20,000 Ci/yr); the Federal drinking water standard is 20,000 pCi/L and the Derived Concentration Guide is 2,000,000 pCi/L.

of institutional control (assumed to be 2150 A.D.) and before migration to the site boundary, the groundwater beneath the Hanford Site will meet 0.04 x Derived Concentration Guide (DCG) for radioactivity from current or future operations. The DCG for a radionuclide is the concentration which, if ingested in drinking water over a period of a year, will result in a dose to the human body of 100 mrem. The standards for nonradionuclides are based on the Washington State maximum contaminant levels (MCLs) specified in the Washington Administrative Code 248-54-175 (WAC 1986).

The Westinghouse Hanford standards for groundwater beneath an active WDF specify that, in general, the concentration may not exceed (0.04) x DCG for detected radionuclides or MCLs for designated nonradioactive constituents.

The exceptions and qualifications to these guidelines are as follows:

- The standards do not apply to tritium; rather, the total quantity of tritium released in the 200 Areas is limited to 20,000 Ci/yr

- For WDFs in the 200 Areas, an allowance is given for radioactive decay that occurs while the contaminants travel in the groundwater to the first point of public exposure, defined as the Columbia River; the modified radionuclide standards are the lesser of:

  - 200 West Area: $2^{(100/\text{half-life})} \times (0.04) \times \text{DCG}$ <u>or</u> $1 \times \text{DCG}$

  - 200 East Area: $2^{(25/\text{half-life})} \times (0.04) \times \text{DCG}$ <u>or</u> $1 \times \text{DCG}$

  where the half-life of the radionuclide is measured in years.

- When more than one radionuclide is present, the summation of the ratios of the concentration of each radionuclide to the concentration limit shall be less than 1

- Groundwater beneath the 1325-N WDF is regulated using a modified set of standards.

The drinking water standards referred to throughout the text are the interim standards defined in EPA (1976) and are used for reference purposes only.

2.2.2 Exceeding the Standards

If the concentration of a constituent in the groundwater beneath an active WDF exceeds an applicable standard, Westinghouse Hanford initiates an investigation to determine if continued disposal to the facility is appropriate. If evaluation of the data indicates that the WDF is responsible for contamination of the groundwater, disposal to the facility is out of compliance and must cease. Disposal may resume only if the facility or effluent stream is modified to prevent further degradation of the aquifer.

3.0 OPERATIONAL GROUNDWATER MONITORING NETWORK

The OGWMN was originally established to observe the response of groundwater to the storage and disposal of radioactive waste in the soil of the 200 Areas. Groundwater monitoring in other operational areas of the Hanford Site was conducted by the contractors responsible for these sites or was covered by the PNL Hanford Site groundwater monitoring program. In 1987, DOE consolidated all operational responsibilities into a single contract to be carried out by one contractor, and a 5-yr contract was awarded to Westinghouse Hanford. To reflect this consolidation, the scope of the operational groundwater management program has expanded to include all operations-related WDFs in the 100, 200, 300, 400, and 1100 Areas. The continued emphasis placed on the 200 Areas is due, in part, to the history of the monitoring program, but also reflects the significance of the 200 Areas as the major waste disposal area on the Hanford Site.

Until recently, groundwater monitoring at the Hanford Site focused, with the exception of nitrate, almost exclusively on radionuclide constituents. Radionuclides were usually the most significant components of disposed waste and were believed to have the greatest potential to degrade the groundwater. The addition of other constituents to groundwater analyses has revealed the presence of several nonradioactive contaminants in the aquifer. The OGWMN now routinely includes both radiological and nonradiological constituents in groundwater analyses.

3.1 OBJECTIVES/SCOPE

The mission of the OGWMN is to provide support information and documentation necessary to demonstrate compliance with DOE groundwater protection policies as outlined in Chapter 2 of this report. The objectives are as follows:

- Assess the quality of groundwater beneath operations-related WDFs for compliance with water quality standards
- Monitor the performance of active and inactive WDFs
- Determine the impact of waste disposal on the groundwater
- Provide groundwater information to Hanford Site waste management programs.

As indicated in the objectives, the OGWMN is primarily concerned with the operation of WDFs. For this reason, monitoring wells are located close to the facilities to detect near-field effects of waste disposal. Far-field impacts on the groundwater fall into the scope of the PNL Hanford Site monitoring program. Since nearly all WDFs on the Hanford Site are located in the 100, 200, 300, 400, and 1100 Areas, the OGWMN is generally limited to these areas.

The following activities are performed to achieve the objectives of the operational groundwater monitoring program:

- Maintenance of groundwater wells and sampling pumps to ensure proper functioning
- Measurement of water levels in wells to produce water-table maps
- Examination of effluent stream compositions to identify contaminants of concern
- Collection of unconfined and confined aquifer samples for laboratory analysis
- Maintenance of groundwater program data bases for convenient access to and analysis of data
- Analysis of data by statistical methods and modelling
- Reporting of results to management
- Auditing of all aspects of the program to ensure the quality of the information generated.

3.2 WELL NETWORK

3.2.1 Well Coverage

During 1988, 410 of the 635 groundwater wells sampled for all monitoring programs provided near-field monitoring of active and inactive WDFs at the Hanford Site. Table 4 shows the distribution of wells by facility area and by monitoring program. Appendix A contains well location maps for the 100, 200, 300, 400, and 1100 Area wells. More than 50% of the near-field wells are located in the 200 Areas, which reflects the significance of these areas to waste management activities.

In 1988, the OGWMN consisted of 183 wells in the unconfined aquifer, primarily in the 200 Areas, and an additional 13 wells in the uppermost confined aquifer north of the 200 East Area. The 1988 monitoring network was identical to the 1987 network with the following exceptions:

- The 1987 network did not include 28 wells in the 100 Areas (which had been monitored by 100 Area personnel) that were counted in the 1988 network
- Three wells northwest of the Gable Mountain Pond site, 6-56-51, 6-59-58, and 6-63-58, were removed from the OGWMN because of their distance from a WDF (two of these wells were picked up by the PNL Hanford Site network)

Table 4. Well Coverage of Hanford Site Waste Disposal Areas in 1988.

Hanford Site area	Groundwater monitoring program		
	Westinghouse Hanford OGWMN	RCRA compliance	PNL Hanford Site[a]
100-B/C	--	--	9
100-D	--	--	3
100-F	--	--	7
100-H	--	23	--
100-K	4	--	3
100-N	24	21	--
200 East	77	48	11
200 West	73	19	13
300	--	37	12
400	--	--	7
600 (landfills)	--	14	--
1100	5	--	--
Totals:	183	162	65

NOTE: Wells shared by more than one monitoring program are counted only in the primary program.
OGWMN = Operational Groundwater Monitoring Network.
PNL = Pacific Northwest Laboratory.
RCRA = Resource Conservation and Recovery Act.
[a]Does not include background and far-field wells in the 600 Area.

- Seven unconfined aquifer wells in the 200 Areas were added to improve coverage (2-E28-19, 2-W11-14, 2-W11-7, 2-W15-2, 2-W15-8, 2-W18-7, and 6-35-70)
- One confined aquifer well, which could not be sampled in 1987 (6-49-55B), was successfully sampled in 1988.

3.2.2 Well Design

Monitoring wells used by the OGWMN were constructed between 1944 and 1987. During this period, three general well designs were implemented (Figure 2). The oldest and simplest design consists of a single 6- or 8-in. (15- or 20-cm)-dia carbon-steel casing, which is perforated at the top of the aquifer. The perforations allow groundwater to enter the well. This design has two major shortcomings: (1) the well lacks a seal that is necessary to block downward movement of contaminants along the outside of the casing and, (2) the size of the perforations are often too large to prevent the entry of sand into the well.

In the early 1980s, a modified design was developed to address these design problems. In the modified design, an 8-in. (20-cm) carbon-steel casing was installed to a depth slightly above the aquifer and perforated along its entire length. A 6-in. (15-cm) carbon-steel casing was then inserted into the first casing and drilling continued to the desired depth. A telescoping stainless-steel screen assembly was lowered to the bottom of the well and the 6-in. (15-cm) casing was pulled back to expose the screen. A grout mixture was pored into the annulus between the two casings and allowed to flow out through the perforations to create a seal between the well and the formation. Finally, a cement surface seal was installed to inhibit erosion at the well head.

Beginning in 1986 and continuing to the present, the sealed, screened well design was further modified to more closely conform with RCRA well construction guidelines recommended by EPA (1986). The implemented changes include placing a sand pack around the screen, sealing the well with bentonite granules or other dry sealant, removing the outer casing as sealant is injected, and completing the well with 4-in. dia (10-cm) stainless-steel casing. To lessen the back-pull friction and permit removal of the temporary outer casing, several progressively smaller casings are often used in deeper wells.

Regardless of the design used, the vast majority of wells at the Hanford Site were drilled using the cable-tool method.

3.2.3 Well Maintenance

A well maintenance program is in place to ensure the integrity of existing wells. The program addresses sample pump malfunctions and other problems that require immediate attention to permit continued sampling of a well, as well as routine well upkeep and preventive maintenance.

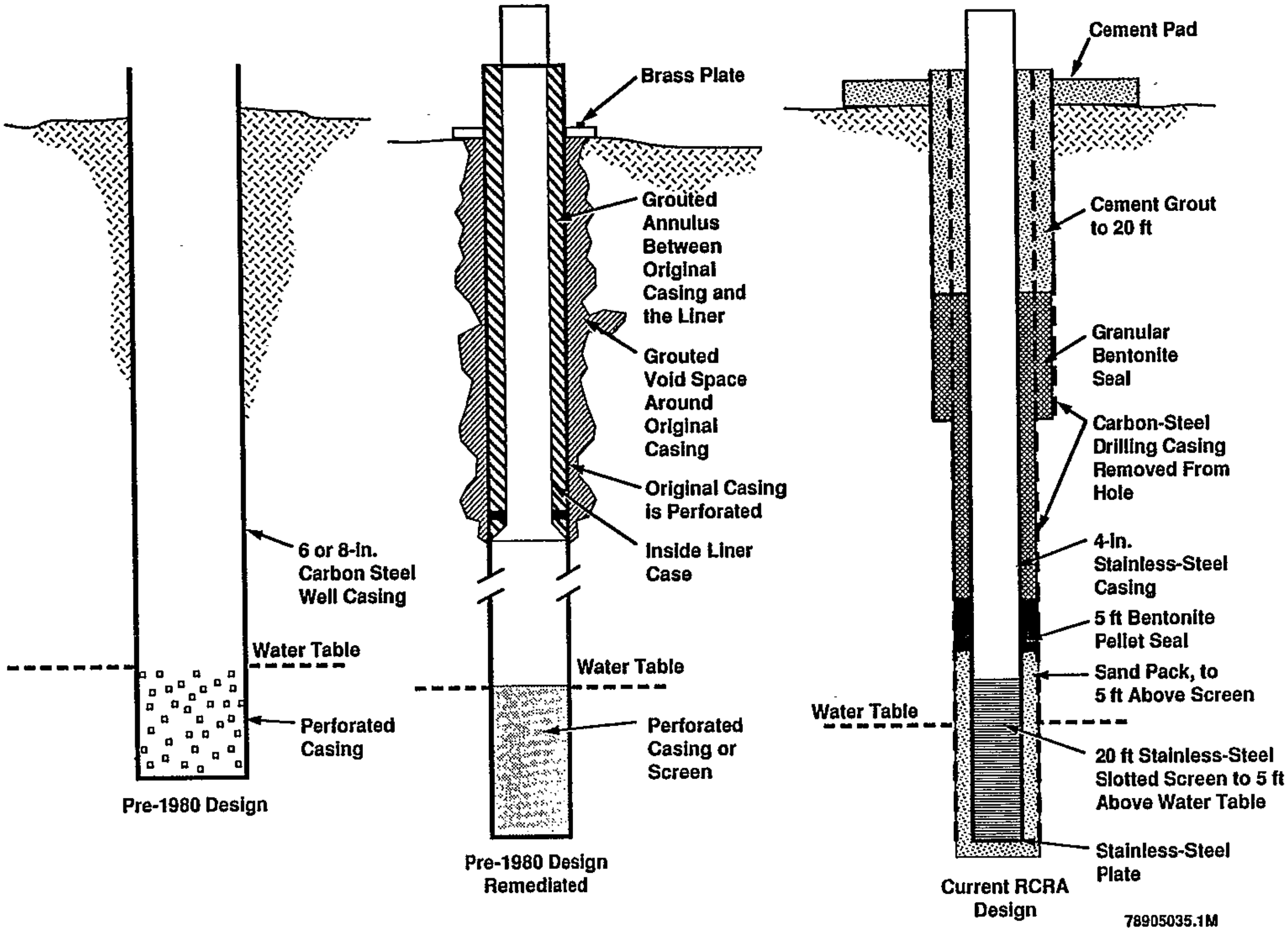

Figure 2. Typical Designs Found in Hanford Site Groundwater Monitoring Wells.

An important component of preventive maintenance is the upgrading of older wells, which were not sealed during construction, to better conform with current standards. Remedial work usually includes grouting around the outside of the casing, installing a surface seal, and emplacement of a well screen, if necessary.

3.3 SAMPLING AND ANALYSIS

Groundwater samples for the OGWMN are collected by PNL environmental monitors according to a predefined schedule developed by Westinghouse Hanford personnel. The samples are then transported to United States Testing Company (U.S. Testing) laboratory where they are analyzed for selected constituents.

3.3.1 Sampling Methods

Groundwater samples are obtained from a well either with a bailer or with a stainless-steel, electric, submersible pump. The majority of wells in the network contain dedicated pumps for sampling. A pumped sample is usually more desirable because water stored in the well casing can be adequately purged before a sample is collected. Bailed samples are only used for radionuclide analyses.

The general procedure for collecting a pumped sample first requires purging the well while monitoring the pH, temperature, and conductivity of the discharge with field instruments. When these parameters stabilize and the well has been purged of a predetermined volume of water, a sample is collected in one or more plastic bottles. If a pump has not been installed, the well cannot be purged and the sample is obtained with a stainless-steel bailer. Sample bottles are placed in a cooler with ice and transported to U.S. Testing within 1 d.

3.3.2 Sampling Frequency

Groundwater samples are collected according to a sampling schedule. Appendix C contains the sampling schedule for 1989, which is similar to the schedule used in 1988. Samples may be collected monthly, quarterly, or semiannually, depending on the location of the well and the magnitude and trend of aquifer contaminants. In general, the criteria for sampling frequency assignments are as follows:

- <u>Monthly</u>
  - Wells located at newly activated WDFs
  - Wells located at active WDFs where elevated contaminants in the groundwater have been observed
  - Any wells where the concentration of a constituent is unexpectedly increasing.

- <u>Quarterly</u>

  - Wells located at older active WDFs where no contamination in the groundwater has been observed

  - Wells located at inactive WDFs where elevated contaminants in the groundwater have been observed.

- <u>Semiannually</u>

  - Wells located at inactive WDFs where no contamination in the groundwater has been observed.

The sampling schedule is modified when changes in the contaminant level or trend warrant an increase or decrease in sampling frequency. A single unexpected result from a well that cannot be attributed to laboratory error is verified by resampling before a change in the schedule occurs.

3.3.3 Analyzed Constituents

Selected radionuclide species and nitrate (Table 5) were the primary constituents analyzed for the OGWMN during 1988. Most well samples are analyzed for gross alpha, gross beta, tritium (^{3}H), and nitrate (as NO_3^-), which are indicators of contamination that might result from Hanford Site operations. Tritium and nitrate, found in many Hanford Site waste streams, are particularly useful in tracking contamination due to their high mobility in the unsaturated zone and in the groundwater. The gross alpha and beta analyses are used to screen for the presence of radionuclides. If alpha or beta levels become elevated, the responsible radionuclide is identified by performing analyses on specific radioactive elements. The major alpha-emitting radionuclides found in the groundwater beneath the Hanford Site are ^{234}U, ^{235}U, ^{238}U, and, at one location, ^{238}Pu and $^{239,240}Pu$. Beta-emitting radionuclides found in the groundwater include fission products such as ^{90}Sr, ^{99}Tc, ^{106}Ru, ^{129}I, ^{137}Cs, short-lived decay products such as ^{234}Th (associated with ^{238}U), and other spent fuel constituents such as ^{60}Co and tritium.

Approximately 50 wells were sampled for nonradioactive chemicals to prepare for the incorporation of nonradioactive constituents into the regular schedule. The constituent suite, similar to that used for RCRA assessment level monitoring, included analyses for metals, ions, volatile and semivolatile organics, and contaminant indicator parameters. The results of this survey, though mentioned in the text along with results from other monitoring programs, are not tabulated in this report due to their preliminary nature.

3.4 WATER-LEVEL MEASUREMENTS

Water-level measurements in the unconfined and confined aquifer beneath the Separations Area (200 Areas and vicinity) are performed semiannually in about 200 wells. The measurements are used to produce maps of the water-table elevation and the piezometric surface of the uppermost confined aquifer.

Table 5. Constituents Commonly Analyzed in the Groundwater.

Constituents	Units	Detection limit
Gross alpha	pCi/L	4
Gross beta	pCi/L	8
Tritium	pCi/L	500
^{60}Co	pCi/L	22
^{90}Sr	pCi/L	5
^{99}Tc	pCi/L	15
^{106}Ru	pCi/L	172
^{129}I	pCi/L	1/15[a]
^{137}Cs	pCi/L	20
^{234}U	pCi/L	0.1
^{235}U	pCi/L	0.1
^{238}U	pCi/L	0.1
^{238}Pu	pCi/L	0.1
$^{239,240}Pu$	pCi/L	0.1
Chemical uranium	ug/L	0.7
Nitrate (as NO_3)	p/b	500/2500[a]

[a]High and low detection limits are available.

The water-table maps are used to determine groundwater flow directions and locate areas where liquid waste disposal has affected the elevation of the water table.

The water-level measurements are collected once during the summer and once in the winter. Each data set is obtained over a period of about 2 wk. Measurements are made with a chalked steel tape to a precision of 0.02 ft (0.006 m), though daily water-level fluctuations combined with possible errors in the wellhead survey result in an overall accuracy of about 0.1 to 0.2 ft (0.03 to 0.06 m). This accuracy is sufficient for producing water-table maps that are contoured at 5-ft (1.5-m) intervals.

3.5 DATA MANAGEMENT

Data generated by the OGWMN are stored in computer data bases for convenient storage, retrieval, and manipulation. The types of data stored include well descriptions, water-level data, water-quality data, sample schedules, and constituent information. Primary data storage for all groundwater monitoring programs on the Hanford Site is on a minicomputer managed by PNL. Data relevant to the OGWMN is downloaded from the PNL system to a microcomputer for analysis and reporting.

3.6 DATA INTERPRETATION AND REPORTING

Data generated by the OGWMN is reviewed by Westinghouse Hanford for consistency, accuracy, trend, and compliance with standards. Following this analysis, the results and interpretations are documented in internal and external reports.

Water-level data are compared to previous measurements in the field, as they are collected, and in the office, before map construction. Values that are not consistent with previous results are remeasured to confirm the difference. If results from one well are inconsistent with values from nearby wells, the well may be investigated to determine if well construction, aquifer hydrogeology, or survey accuracy are causing the discrepancy. Once the data are screened, the water levels are hand contoured using the field measurements to produce the final map. The map and data are published semiannually as an external document (e.g., Schatz and McElroy 1988).

A groundwater analytical result is first compared to previously collected values from the same well to determine if a significant variation has occurred. If a significant difference is observed in only one constituent, the sample is reanalyzed; if other constituents also show change the well may be resampled. Analytical results for specific radionuclides are evaluated against the corresponding gross alpha and beta values to ensure that all radioactivity is accounted for. Once these data quality checks have been performed, the concentration levels are compared to the permissible standards to determine if the groundwater is in compliance with regulations. Data are also examined for trends by computing regression values or by visual inspection of concentration history plots. Maps showing the extent of specific constituents are prepared to gain a better understanding of contaminant sources and plume movements. Finally, the sampling schedule is reevaluated to determine if additional data are necessary or if analyses from certain wells are no longer useful and may be cancelled.

Results from the OGWMN are evaluated, summarized, and reported each quarter to Westinghouse Hanford management. Midway through the year an annual report (e.g., this report, Serkowski et al. 1988; Law, Serkowski, and Schatz 1987; Law et al. 1986), is issued to present a detailed description of operational groundwater monitoring activities and results for the previous calendar year.

4.0 RESULTS

This chapter presents a discussion of the results obtained from the OGWMN during CY 1988. The presentation is divided into five major sections. Section 4.1 briefly describes the results of water-level measurements taken in the 200 Areas. The next three sections discuss the results of chemical analyses performed on unconfined aquifer samples. Section 4.2 summarizes the effluent and groundwater characteristics of every monitored active WDF on an individual basis. Section 4.3 is a review of groundwater quality beneath selected inactive WDFs where elevated contaminants have been observed. Section 4.4 describes widely distributed groundwater constituents in terms of contamination plume source, extent, and movement. Section 4.5 is a discussion of potential aquifer intercommunication north of the 200 East Area, including results of confined aquifer analyses.

4.1 WATER-LEVEL MEASUREMENTS

Water-level measurements in almost 200 Separations Area wells which are open to the unconfined aquifer were collected in June (Schatz and McElroy 1988). A second set of measurements, normally scheduled for December, were not collected until January 1989 (Kasza and Schatz 1989) and are not summarized in this year's report.

The elevation and gradient of the water table in the unconfined aquifer beneath the 200 Areas are significantly affected by liquid waste disposal to the soil column. Cooling water disposed to ponds has formed groundwater mounds beneath three high-volume disposal sites: U Pond in the 200 West Area, B Pond east of the 200 East Area, and Gable Mountain Pond north of the 200 East Area. Compared with pre-Hanford conditions (Newcomb et al. 1972), the water table has risen approximately 35 ft (11 m) beneath B Pond and 15 ft (5 m) under Gable Mountain Pond, which was deactivated in 1987. The water table under U Pond rose approximately 65 ft (20 m) while it was in operation, but has declined about 8 ft (2.4 m) from that level since the pond was deactivated in 1984.

The water table of the Separations Area map produced from the June measurements is shown in Figure 3. The configuration of the water table has not changed significantly from previous measurements (Schatz 1987). The water-table contours indicate that the groundwater flows from west to east across the 200 West Area. A steep drop in the water table occurs between the 200 West and 200 East Areas resulting from an increasing aquifer hydraulic conductivity toward the east. Under the 200 East Area, the flow divides with one path moving to the southeast and the other path turning to the north through the gap between Gable Mountain and Gable Butte. The uniformity of water-table elevations within the 200 East Area due to high hydraulic conductivities makes determination of a hydraulic gradient beneath many 200 East Area WDFs difficult. The water-table mound beneath the active B Pond produces a localized radial gradient. This mound continues to grow, while water levels beneath the deactivated U Pond and Gable Mountain Pond are generally decreasing.

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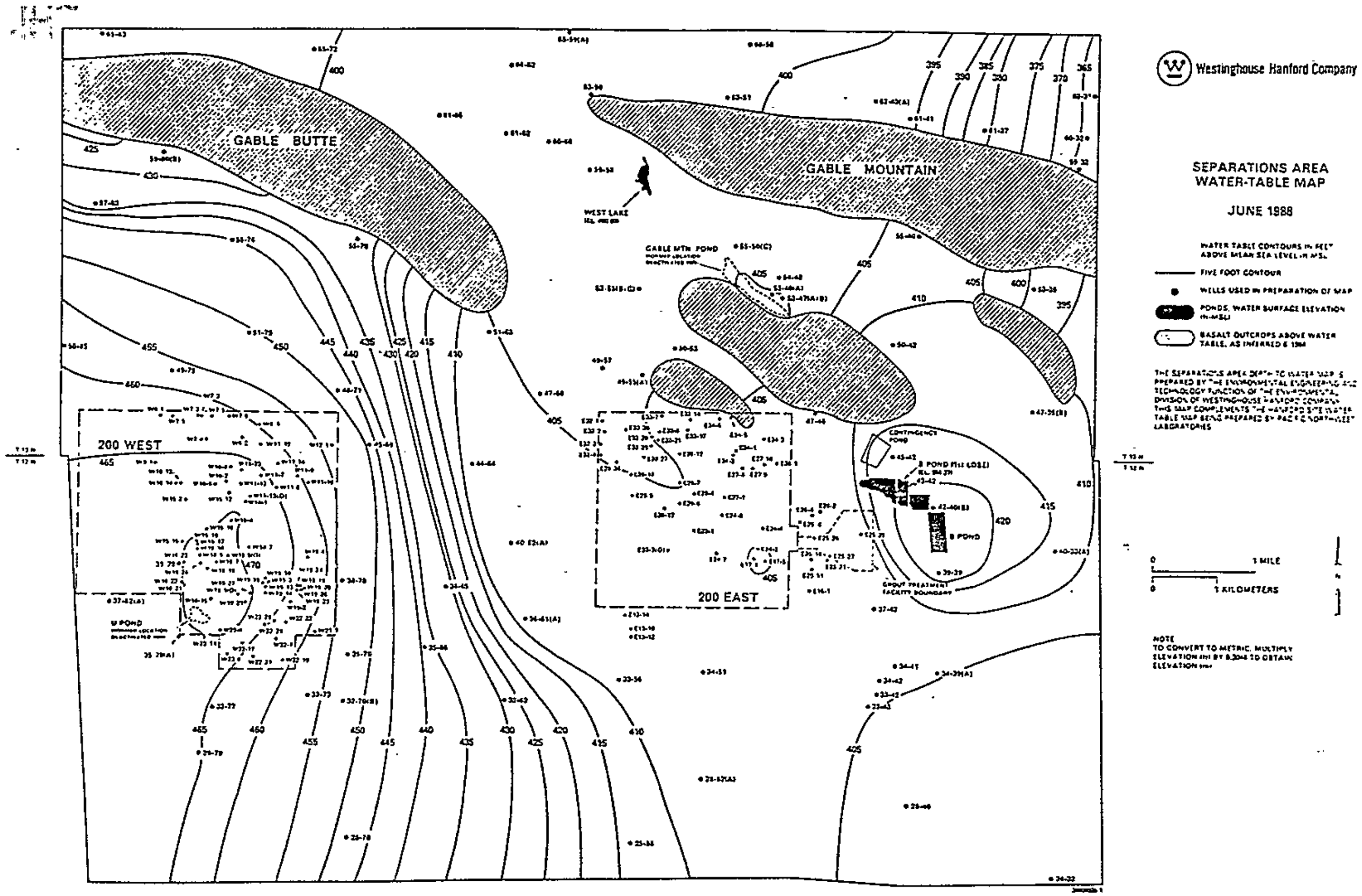

Figure 3. 200 Areas Water Table Map, June 1988.

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In the areas along the Columbia River, i.e., the 100 Areas and the 300 Area, groundwater flow is influenced by fluctuations in the river stage. When the river stage is above the water table, water flows from the river into the groundwater. Therefore the groundwater flow near the river is dependent the discharge from Priest Rapids Dam located upstream of the Hanford Site.

4.2 GROUNDWATER QUALITY AT ACTIVE WASTE DISPOSAL FACILITIES

Active WDFs either received waste or were prepared to receive waste during 1988, or, in the case of storage facilities, contained waste during 1988. Active WDFs are located in the 100, 200 East, 200 West, 300, 400, and 600 Areas of the Hanford Site. Appendix A contains well location maps for all active WDFs discussed in this section. Table 6 summarizes the active WDFs and their respective waste sources and volumes. The following sections include discussions of each active WDF in terms of the operations that they service, the nature of the effluent that they receive, their monitoring well coverage, and the quality of the groundwater beneath them. The presence, magnitudes, and trends of elevated groundwater constituents form the basis for describing groundwater quality. Appendix B contains a tabulation of the data collected for the OGWMN only, though additional data collected for other groundwater monitoring programs is the basis for some of the following discussions.

4.2.1 100 Area Active Waste Disposal Facilities

Several active WDFs are located in the 100 Areas and most are associated with water treatment facilities in the 100-B/C, 100-D, and 100-N Areas. The water-treatment waste consists primarily of filter backwash water disposed to percolation ponds, though demineralization columns must be regenerated periodically, which can produce corrosive waste. The 100-B/C and 100-D water-treatment waste ponds do not have near-field groundwater monitoring. The process waste stream from N Reactor in the 100-N Area is the only other active discharge to the soil. In early 1988, the N Reactor was placed on cold standby status thereby reducing the volume of effluent generated.

4.2.1.1 1324-NA Pond. The 1324-NA Pond is located south of the reactor building in 100-N Area (Appendix A, Figure A-3). The facility is currently used to dispose of nonhazardous and nonradioactive liquid waste from the 100-N water-treatment plant. The pond received hazardous waste until 1983.

The 1324-NA Pond has been monitored for RCRA compliance since the end of 1987. Five wells, 1-N-58 through 1-N-61 and 6-81-58 (Appendix A, Figure A-3), are used to monitor the facility. Details of the monitoring activities and results are presented in Fruland and Lundgren (1989). Concentrations of sodium and sulfate have been elevated but stable since monitoring began. Sulfate and specific conductivity are above the control standards. Radionuclide contamination has not been detected at this site.

4.2.1.2 1325-N Waste Disposal Facility. The 1325-N WDF is located in 100-N Area just east of N Reactor (Appendix A, Figure A-3). The facility began receiving waste in 1983 and became the primary liquid waste disposal system for the N Reactor in 1985. The effluent includes a wide variety of

Table 6. Active Monitored Waste Disposal Facilities at the Hanford Site.

Hanford Site area	Waste disposal facility	Effluent source	Effluent stream	1988 volume (L)
100-N	1324-NA Pond	163-N Building	Demineralizer waste water	600,000,000[a]
	1325-N Crib	N Reactor	Cooling water	600,000,000
200 East	216-A-8 Crib	AY, AZ Tank Farm	No discharge in 1988	0
	216-A-30 Crib	PUREX	Steam condensate	250,000,000
	216-A-37-1 Crib	242-A Evaporator	Process condensate	49,500,000
	216-A-37-2 Crib	PUREX	Steam condensate	123,000,000
	216-A-45 Crib	PUREX	Process condensate	49,700,000
	216-B-3 Pond	PUREX/B Plant	Chemical sewer/cooling water	26,700,000,000
	216-B-55 Crib	B Plant	Steam condensate	2,650,000
	216-B-62 Crib	B Plant	No discharge in 1988	0
	216-B-63 Ditch	B Plant	Chemical sewer	289,000,000
	A, B, and C Tank Farms	Various	Stored waste	--
	Low-Level Burial Grounds	Various	Solid waste	--
200 West	216-S-25 Crib	242-S Evaporator/ SX Tank Farm	SX steam condensate	935,000[a]
	216-S-26 Crib	222-S Laboratory	Chemical sewer	18,900,000
	216-U-14 Ditch	UO_3 Plant/242-S Evaporation	Steam condensate/cooling water	287,000,000
	216-U-17 Crib	UO_3 Plant	Process condensate	722,000
	216-W-LWC Crib	Laundry	Laundry waste water	14,000,000
	216-Z-20 Crib	Plutonium Finishing Plant	Cooling water	229,000,000
	S, T, and U Tank Farms	Various	Stored waste	--
	Low-Level Burial Grounds	Various	Solid waste	--
300	Process Trenches	Various	Chemical sewer/cooling water	2,000,000,000
600	Solid Waste Landfill	Various	Solid waste	--

[a]Estimate.

generally short-lived fission products, though the inventory also included ^{60}Co, ^{90}Sr, and ^{99}Tc. The quantity of radionuclides in the effluent decreased substantially with the shutdown of N Reactor in 1987. Liquid discharges to the 1325-N travel a short distance in the soil and resurface at the N Springs, which are located along the shore of the Columbia River. The N Springs discharges are regulated by a disposal permit as direct discharges to the river (Rokkan 1988).

The 1325-N WDF has been monitored for RCRA compliance since late 1987. Eleven wells currently monitor the facility (Appendix A, Figure A-3). Details of the monitoring activities and results are presented in Fruland and Lundgren (1989). Elevated concentrations of ^{60}Co, ^{90}Sr, tritium, nitrate, and coliform bacteria have been observed in some of the wells. Strontium-90 levels continue to increase in several wells, while tritium readings are stable and ^{60}Co concentrations are decreasing. Nitrate concentrations are slightly above control standards but are decreasing.

4.2.2 200 East Area Active Waste Disposal Facilities

The 200 East Area and vicinity contains the greatest number of active WDFs on the Hanford Site (Figure 4). The WDFs service operations at PUREX, B Plant, the 242-A Evaporator, and the tank farms. Waste disposal facilities include cribs, ditches, ponds, underground storage tanks, and burial grounds. One active WDF is identified as causing a detectable increase in the concentration of a groundwater constituent: the 216-A-37-1 Crib. Contamination observed in wells monitoring the other active WDFs results from discontinued waste disposal practices.

4.2.2.1 216-A-8 Crib. The 216-A-8 Crib is located east of the 241-AX Tank Farm outside the 200 East Area perimeter fence (see Figure 4). When it is in operation, the crib receives steam coil condensate (A8 stream) from the 241-A, -AY, and -AZ Tank Farms. The crib received waste during 1956 to 1958, 1966 to 1976, 1978, and 1983 to 1985. No effluent has been discharged to this crib since 1985.

Wells 299-E25-6 and 299-E25-9 monitor this crib (see Appendix A, Figure A-5). Average concentrations of all monitored constituents are below the control standards. The concentrations in 1988 were similar to the results for 1987.

4.2.2.2 216-A-30 Crib. The 216-A-30 Crib is located just outside the perimeter fence near the southeastern corner of the 200 East Area (see Figure 4). This crib receives about two-thirds of the PUREX steam condensate (SCD stream) effluent stream, the remainder being routed to 216-A-37-2 Crib (Section 4.2.2.4). The volume of effluent discharged to the crib during 1988 was 6.61 x 10^7 gal (2.50 x 10^8 L), or more than twice last year's volume though still about half of the volume discharged in 1986 (Aldrich 1987). No significant quantities of radionuclides were detected in the SCD effluent stream.

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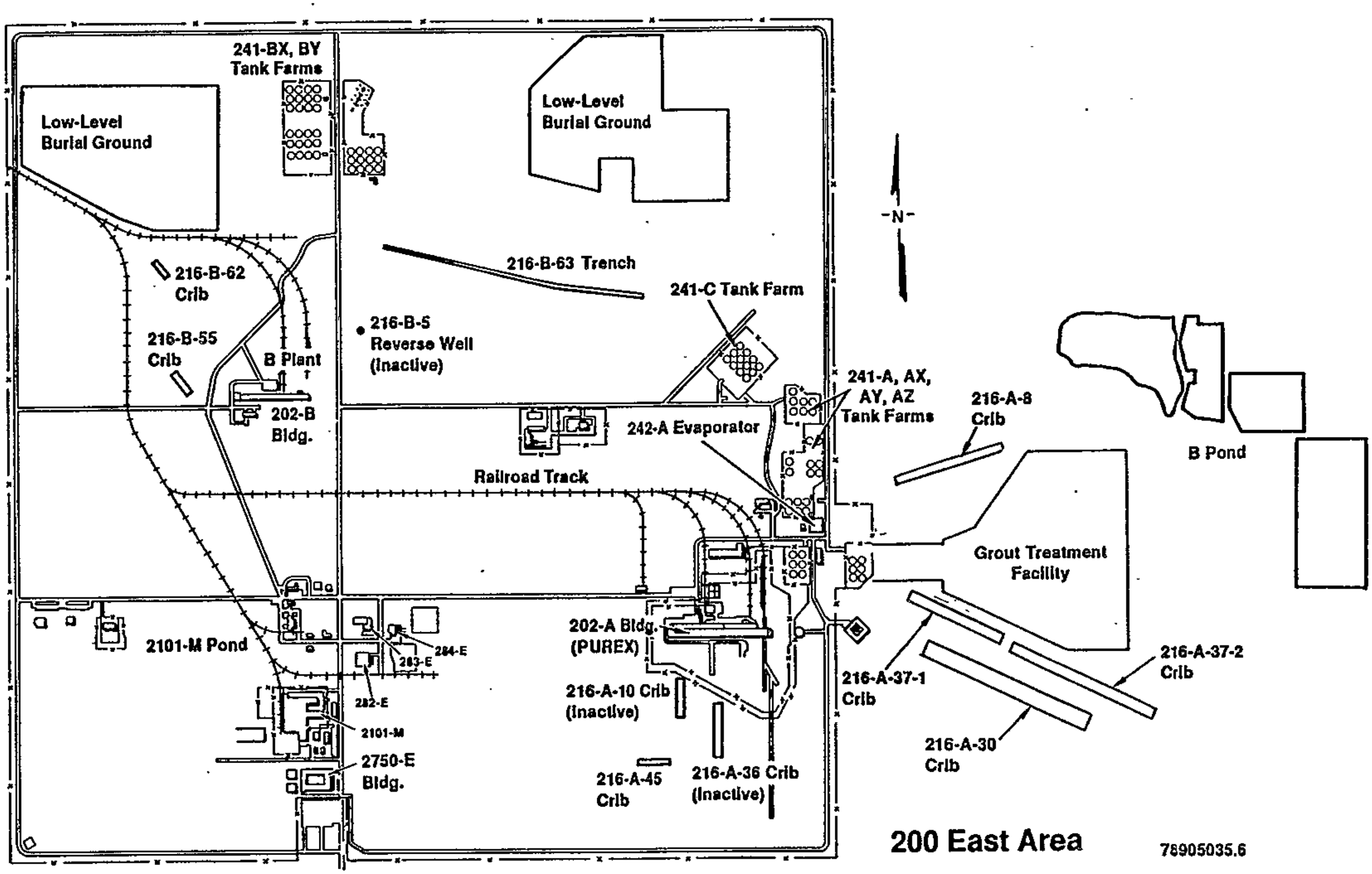


Figure 4. Location Map for Selected Liquid Waste Disposal Sites in the 200 East Area.

Wells 299-E16-2 and 299-E25-11 (see Appendix A, Figure A-8) monitor the crib. The tritium concentration continues to increase slightly in well 299-E25-11 to about 25% of the DCG. This tritium, which is not detected in the other monitoring well, is attributed to the 216-A-37-1 Crib, which is located upgradient and receives moderate quantities of tritium (Figure 5). Nitrate concentrations, also elevated in 299-E25-11, remain just below the control standard and are stable.

4.2.2.3 216-A-37-1 Crib. The 216-A-37-1 Crib is located just outside the perimeter fence near the southeastern corner of the 200 East Area (see Figure 4). Process condensate from the 242-A Evaporator (AFPC stream), which contains significant quantities of tritium and detectible levels of fission products, is disposed to the crib after retention and monitoring in the concrete 207-A Retention Basin. The crib has been active since 1977. In 1988, a total of 1.31×10^7 gal (4.95×10^7 L) of effluent was disposed to the crib, almost twice the 1987 volume.

The crib is monitored by four wells, 299-E25-17 through 299-E25-20 (see Appendix A, Figure A-10). All of the wells show elevated levels of gross beta, tritium, and nitrate, which fluctuate uniformly on about an annual basis. The annual cycle, which is most pronounced in well 299-E25-19 (Figure 6), may reflect a variation in effluent concentrations during various stages of the 242-A processing campaigns. Tritium in all wells exceeds the drinking water standard and in well 299-E25-19 it also exceeds the DCG. Nitrate is above the control standards in wells 299-E25-19 and 299-E25-20.

4.2.2.4 216-A-37-2 Crib. The 216-A-37-2 Crib is located just outside the perimeter fence near the southeastern corner of the 200 East Area (see Figure 4). This crib began operating in 1984 and receives about one-third of the PUREX steam condensate (SCD stream) effluent stream, the remainder being routed to 216-A-30 Crib (see Section 4.2.2.2). The volume of effluent discharged to the crib during 1988 was 3.25×10^7 gal (1.23×10^8 L), or more than twice last year's volume though it was still about half of the volume discharged in 1986 (Aldrich 1987). No significant quantities of radionuclides were detected in the SCD effluent stream.

Four wells monitor the crib, 299-E25-21 through 299-E25-24 (see Appendix A, Figure A-11). Concentrations of all analyzed constituents are below control standards and similar to 1987 levels.

4.2.2.5 216-A-45 Crib. The 216-A-45 Crib is located south of the PUREX Plant inside the 200 East Area (see Figure 4). The crib has received the PUREX process distillate discharge waste stream (PDD stream) since 1987, when it replaced the deactivated 216-A-10 Crib (see Section 4.3.2.1). The PDD stream contains high concentrations of tritium and detectable levels of ^{129}I and transuranics. In 1988, a total of 1.31×10^7 gal (4.97×10^7 L) of effluent were discharged to the crib.

Figure 5. Tritium Concentration History of Well 299-E28-11 at the 216-A-30 Crib.

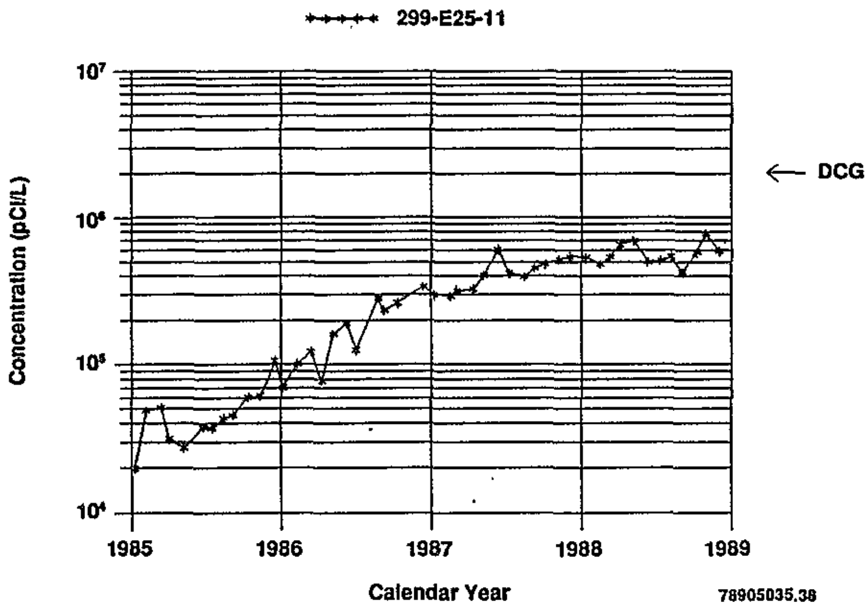
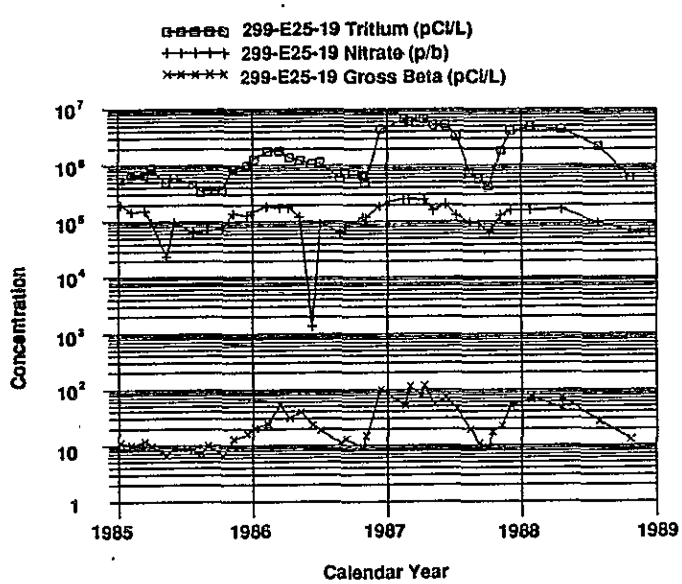
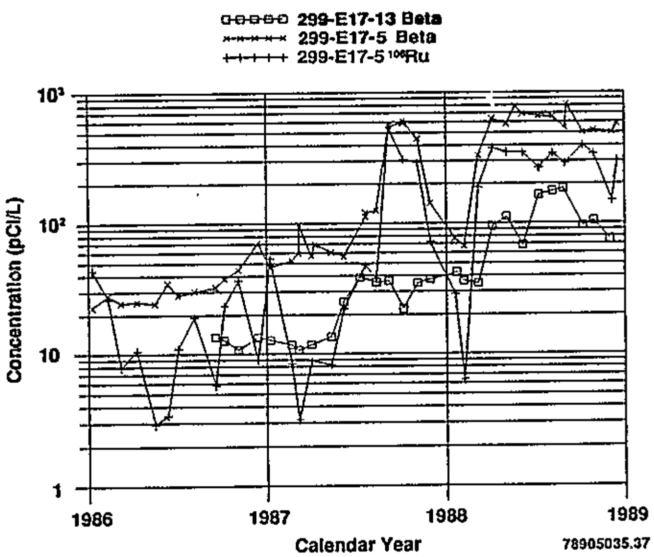


Figure 6. Tritium, Gross Beta, and Nitrate Concentration Histories of Well E299-E25-19 at the 216-A-37-1 Crib.



Wells 299-E17-12 and 299-E17-13 monitor the crib (see Appendix A, Figure A-12). Tritium and nitrate have been elevated in both wells since monitoring began in 1986. Concentrations of these constituents have been declining since 1987. Because 216-A-45 did not begin operating until 1987, disposal to the crib is not responsible for these contaminants. The nearby inactive 216-A-10 and 216-A-36B Cribs are probable sources for the tritium and nitrate contamination. Gross beta has steadily increased in both monitoring wells since 1986, peaking at more than 100 pCi/L in mid-1988 (Figure 7). The beta is attributed to ^{106}Ru. Ruthenium-106 is a short-lived (366-d half-life) radionuclide that was present in significant quantities in the effluent discharged to the 216-A-36B Crib before it was deactivated in 1987. Although ^{106}Ru concentrations are below the detection limit in the 216-A-45 Crib wells, evidence that this radionuclide may be present is indicated by the close correlation between gross beta and ^{106}Ru concentrations at a well monitoring the 216-A-36B Crib (299-E17-5) and the gross beta in wells at the 216-A-45 Crib (see Figure 7). Except for nitrate, no other sampled constituents exceed the control standards in the groundwater beneath the 216-A-45 Crib.

Figure 7. Comparison of the Gross Beta and ^{106}Ru Concentrations in Well 299-E17-5 at the Inactive 216-A-36B Crib with Gross Beta Concentrations in Well 299-E17-13 at the 216-A-45 Crib.



4.2.2.6 216-B-3 Pond System. The 216-B-3 Pond system (B Pond) is located approximately 1 mi (1.6 km) east of the 200 East Area (see Figure 4). The pond system consists of a 34-acre (13.76-ha) main pond, 216-B-3, which spills into two 11-acre (4.45-ha) expansion ponds, 216-B-3A and 216-B-3B, and a third expansion pond of 41 acres (16.6 ha), 216-B-3C. An unused contingency pond is located north of the main pond for use in case of an emergency. A variety of the 200 East Area effluent streams feed into the pond system via two unlined ditches, 216-A-29 and 216-B-3-3.

The volume of effluent entering B Pond far surpasses any other Hanford liquid WDF. The 7.05 x 10^9 gal (2.67 x 10^{10} L) of liquid disposed to the ponds in 1988 accounts for 94% of liquid waste discharged to the ground in the 200 Areas. A 20% increase in liquid discharged to the pond occurred between 1987 and 1988. This was due, in part, to the rerouting of effluent from the deactivated Gable Mountain Pond to B Pond in 1987. Though moderate quantities of tritium are present in the B Pond influent, the tritium concentration entering the ground is minimal due to the large discharge volume. Contamination spills occurred in 1964 and 1970 adding considerable quantities of ^{90}Sr to the soil column of the main pond 216-B-3.

Until RCRA monitoring at B Pond was initiated in 1988, three wells monitored the ponds: 699-42-40A, 699-42-40B, and 699-45-42. An additional five wells were installed around B Pond in 1988 for the RCRA monitoring project (see Appendix A, Figure A-13), though only a single sampling occurred in 1988 (Fruland and Lundgren 1989). All constituents are below control standards. Tritium is above drinking water standards in well 699-45-42 approximately 1 mi (1.6 km) north of the pond and in a single sample from a new RCRA well just south of the pond. The tritium concentration in well 699-45-42 has been decreasing since 1971.

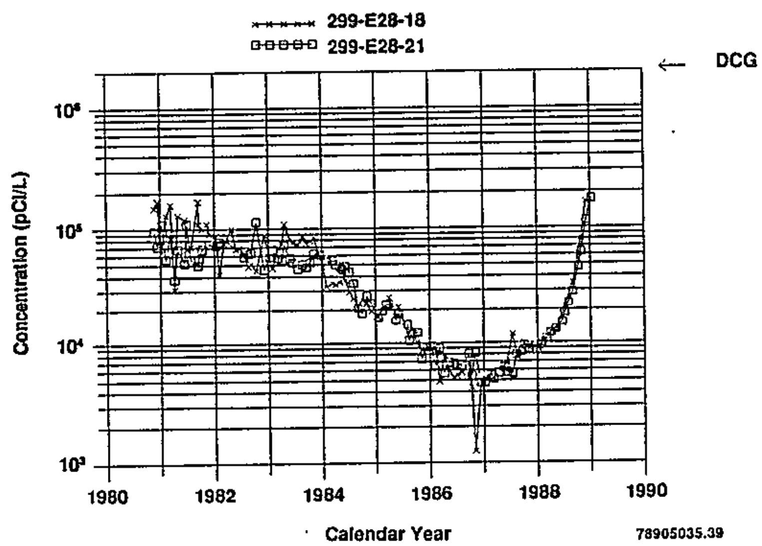
4.2.2.7 216-B-55 Crib. The 216-B-55 Crib is located west of B Plant in the northwestern part of the 200 East Area (see Figure 4). Steam condensate waste (BCS stream) from B Plant has been disposed of in the crib since 1967, except during 1987 when the crib was not used. The BCS stream has a relatively low volume, with 7.00 x 10^5 gal (2.65 x 10^6 L) discharged in 1988, and does not contain significant amounts of radionuclide contaminants.

Wells 299-E28-12 and 299-E28-13 monitor the crib (see Appendix A, Figure A-15). Average concentrations of analyzed constituents are all below control standards. Nitrate in well 299-E28-13 is just below the control standard but only two samples for this constituent have been collected to date so a trend cannot be determined. However, increasing nitrate levels in wells to the southeast and northwest suggest that a plume may be moving through the area (Section 4.4.3) and concentrations beneath the 216-B-55 Crib may rise in the future.

4.2.2.8 216-B-62 Crib. The 216-B-62 Crib is located northwest of B Plant in the northwestern part of the 200 East Area (see Figure 4). The crib receives the B Plant process condensate stream (BCP stream), which historically has contained low levels of ^{90}Sr and ^{137}Cs. However, no effluent has been sent to the crib since 1986.

Three wells provide monitoring of the crib, 299-E28-18, 299-E28-19, and 299-E28-21 (see Appendix A, Figure A-16). Although no analyzed constituents exceeded the control standards in 1988, tritium, which was already above the drinking water standard, increased abruptly in 1988 (Figure 8). In addition, nitrate concentrations, which had been declining along with tritium levels until 1987, are also beginning to climb. Because tritium was not disposed in large concentrations to the 216-B-62 Crib, the contamination is probably originating elsewhere. Tritium increases have been observed in several wells between 216-B-62 Crib and the WDFs south of PUREX (Section 4.4.2), but well coverage is too sparse to determine whether a connection exists. Meanwhile, elevated uranium concentrations, believed to have come from uranium disposal at the nearby inactive 216-B-12 Crib, continue to decrease.

Figure 8. Tritium Concentration Histories of Wells 299-E28-18 and 299-E28-21 at the 216-B-62 Crib.



4.2.2.9 216-B-63 Ditch. The 216-B-63 Ditch is located in the north-central 200 East Area (see Figure 4). The ditch is approximately 5 to 8 ft (1.5 to 2.4 m) deep, 8 ft (2.4 m) wide, and 1,600 ft (488 m) long, though only half that length is normally wetted. The B Plant chemical sewer stream (BCE stream) delivered about 7.56 x 10^7 gal (2.89 x 10^8 L) of effluent to the ditch in 1988. No significant levels of radionuclides were detected in the BCE effluent stream.

Well 299-E34-1 is currently being used to monitor the ditch (see Appendix A, Figure A-17), though its location in relation to the ditch is poor. The recently declared RCRA status of the site will result in the drilling of additional wells to improve monitoring coverage. Monitored groundwater constituents did not exceed control standards and are consistent with previous results.

4.2.2.10 200 East Area Tank Farms. The 200 East Area contains 91 underground tanks for the storage of high-level liquid and solid radioactive waste. One group of tank farms (241-A, -AN, -AP, -AW, -AX, -AY, -AZ, and -C) is located near the eastern perimeter fence while the remainder (241-B, -BX, and -BY) are located near the northwestern corner of the 200 East Area (see Figure 4). The tank farms include both the older single-shelled and the newer double-shelled steel tanks. Based on liquid-level monitoring data, as many as 32 of the single-shelled tanks, predominantly at the 241-B, -BX, -BY, and -C Tank Farms, have been found to have leaked some of their contents into the ground (Thurman 1989). None of the double-shelled tanks, which continue to receive waste, have been found to be leaking. In addition to liquid-level surveillance, the tanks are monitored by a network of vadose-zone wells which are routinely logged with gross-gamma detection probes. Geophysical logs indicate very little downward movement of contamination in the vadose zone.

Groundwater monitoring beneath the tank farms currently is accomplished by using available wells in the vicinity of the tanks. Many of these wells were originally drilled to monitor liquid WDFs adjacent to the tank farms. Recently developed plans call for a significant improvement in the groundwater well coverage of the single-shelled tanks.

Though elevated levels of certain constituents have been detected in wells close to the 200 East Area tank farms, no groundwater contamination is currently attributed to leaks in the tanks. Well 299-E25-13, located in the 241-AX Tank Farm, has had nitrate levels above the control standards, though levels are decreasing. No other wells in the immediate region surrounding tank farms near the eastern perimeter fence have elevated concentrations of analyzed constituents. Contaminated groundwater is present north of the 241-B, -BX, and -BY Tank Farms. However, it is believed to result from disposal to the BY Cribs in the late 1950s (Section 4.3.2.3).

4.2.2.11 218-E Low-Level Burial Grounds. Low-level burial grounds are located in the northern one-third of the 200 East Area (see Figure 4). Groundwater monitoring of LLBGs in the 200 East Area is limited to the 218-E-10 (WMA-1) and 218-E-12B (WMA-2) burial grounds. The LLBGs have received solid radioactive, transuranic, and radioactive-mixed waste since 1944 from facilities all over the Hanford Site. Currently, no hazardous waste is being buried in the LLBGs unless it is inseparable from a radioactive waste. The waste is typically buried within the top 50 ft (15 m) of soil with a minimum of 8 ft (2.4 m) of overlaying back fill.

Groundwater monitoring of WMA-1 and WMA-2 is provided by a RCRA compliance project which began sampling in 1988. Sixteen wells were drilled and all but one are sampled for the project. A summary of the sampling results can be found in Fruland and Lundgren (1989). Tritium readings above drinking water standards are found in four WMA-1 wells, one of which, 299-E28-26, also has nitrate concentrations above control standards and elevated gross alpha and gross beta levels. No control standards or drinking water standards are exceeded in wells at WMA-2.

4.2.2.12 Grout Treatment Facility. The Grout Treatment Facility (GTF) is located east of the 200 East Area between B Pond and the perimeter fence (see Figure 4). The grout process involves mixing liquid effluent in a special grout matrix. The grouted waste is poured into subsurface concrete vaults and allowed to solidify, thus stabilizing the waste. The facility began receiving test waste in August 1988 and is scheduled to begin receiving mixed waste from the tank farms in late 1990.

Five wells are monitored for the RCRA compliance project established at the GTF. An additional six wells are sampled to help characterize the response of the groundwater to adjacent WDFs. The well locations and background data results are summarized in Fruland and Lundgren (1989). Unfiltered chromium is above control standards in two of the newly constructed wells, but is decreasing and may be the result of insufficient well development. All other constituents are below control standards, although tritium is above drinking water limits in several wells.

4.2.3 200 West Area Active Waste Disposal Facilities

Active WDFs in the 200 West Area (Figure 9) are primarily associated with the PFP (234-5Z Building), the UO_3 Plant (224-U Building), the 222-S Laboratory, and the laundry building (2427-W Building). Additionally, the area contains tank farms for high-level waste and burial grounds for low-level solid waste. The groundwater beneath several minor active WDFs, including the 216-S-10, 216-T-1, and 216-T-4-2 Ditches, is not monitored due to the low volume or low concentration of the effluent discharged to them. Elevated groundwater contamination beneath WDFs in the 200 West Area all result from discontinued disposal practices.

4.2.3.1 216-S-25 Crib. The 216-S-25 Crib is located just outside the perimeter fence in the southwestern part of the 200 West Area (see Figure 9). The crib received process condensate from the 242-S Evaporator from 1973 to 1980, and in 1985 received treated groundwater from the vicinity of the 216-U-1/2 Cribs for a 6-mo period. The treated groundwater had elevated nitrate and uranium concentrations. The crib also receives a small volume of steam condensate waste from the 241-SX Tank Farm.

The crib is monitored by three wells, 299-W23-9, 299-W23-10, and 299-W23-11 (see Appendix A, Figure A-18). All three wells continue to show elevated, but stable uranium concentrations. Nitrate is above control standards and tritium (Figure 10) is above drinking water standards in wells 299-W23-9 and 299-W23-10, though levels are steady or decreasing. Concentrations of these three constituents increased for approximately 1 yr after the 1985 ion-exchange discharge to the crib. Because tritium was not a component of the 1985 stream, some of this increase may have resulted from remobilization of waste previously disposed to the crib. Substantial quantities of tritium may have been disposed to the 216-S-25 Crib and the nearby inactive 216-S-21 Crib before 1980, though effluent records for tritium disposed to these facilities are poor. This is supported by large increases in tritium at wells monitoring the 216-S-25 Crib during 1974 (Figure 10) and a large increase in tritium concentration in well 299-W23-4 at the 216-S-21 Crib during 1988. The cause for this latest increase has not been established.

Figure 9. Location Map for Selected Liquid Waste Disposal Sites in the 200 West Area.

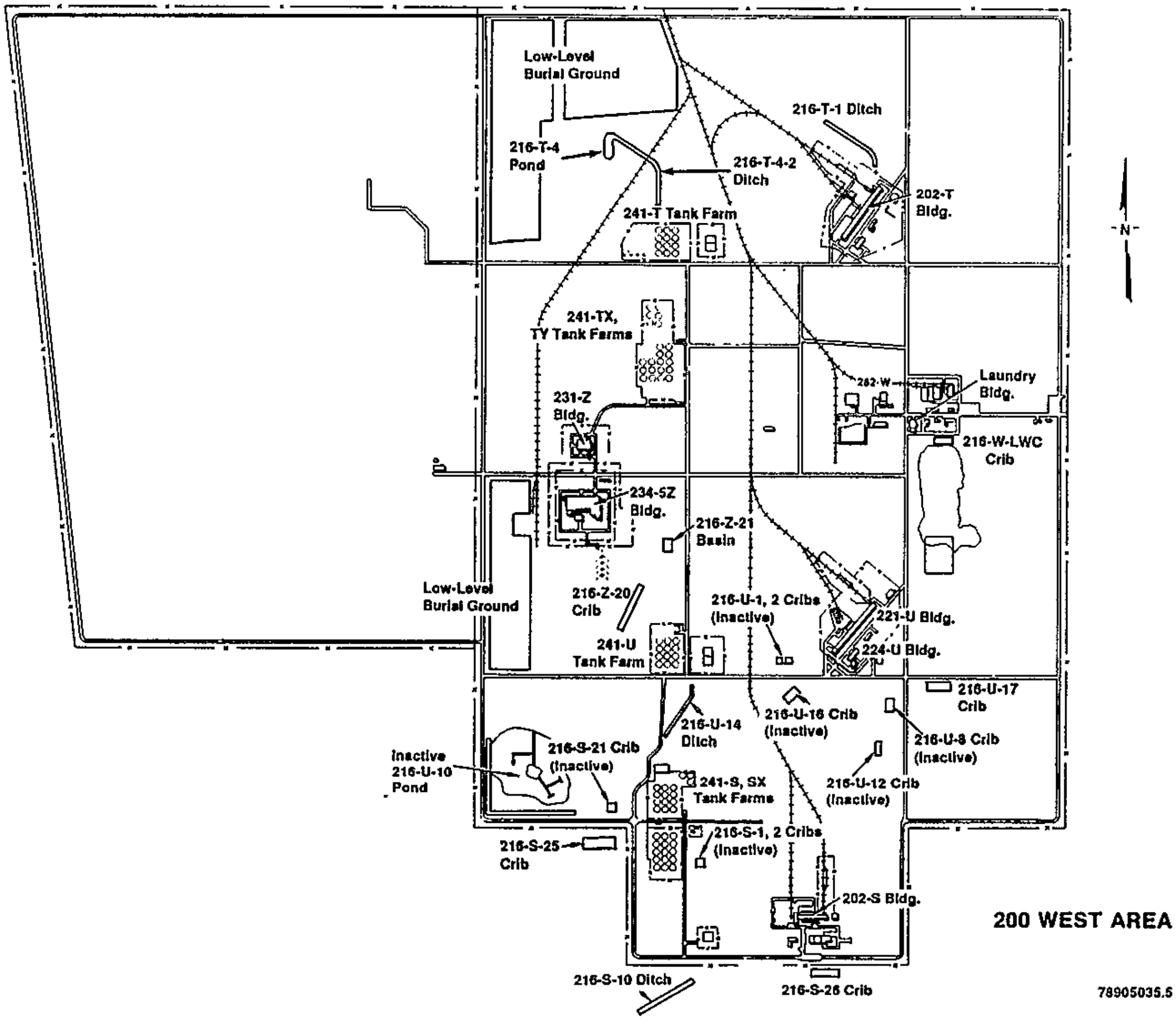
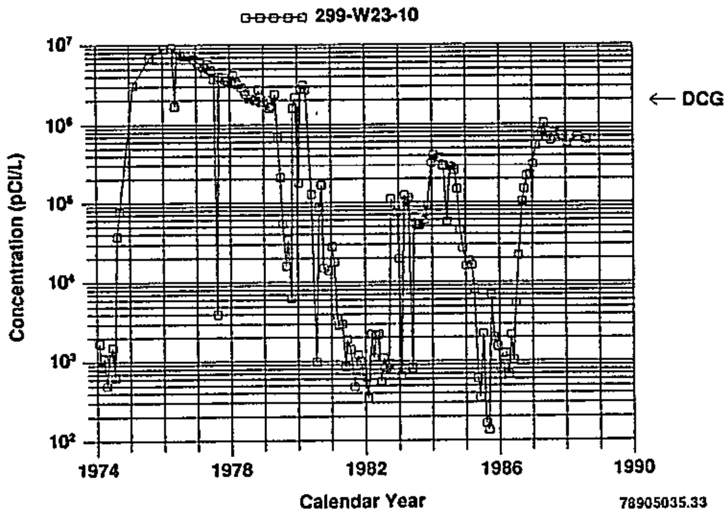


Figure 10. Tritium Concentration History in Well 299-W23-10 at the 216-S-25 Crib.



4.2.3.2 216-S-26 Crib. The 216-S-26 Crib is located just outside the southern boundary of the 200 West Area (see Figure 9). The crib has received steam condensate and sink waste from the 222-S Laboratory since 1984. Discharge to the crib ceased in September 1988 and was rerouted to the 216-S-10 Ditch when crib liquid levels exceeded operating limits. The crib will need to be modified to improve infiltration before discharge can resume. No significant quantities of radionuclides were observed in the waste stream to the crib, which amounted to 4.99 x 10^6 gal (1.89 x 10^7 L) in 1988 before the shutdown.

The crib is monitored by well 299-W27-1 (see Appendix A, Figure A-19). Average nitrate concentration is just below the control standard and is decreasing slightly. The uranium concentration, though well below the control standard, increased slightly over 1987 levels.

4.2.3.3 216-U-14 Ditch. The 216-U-14 Ditch is located between U Plant (202-U Building) and the inactive U Pond in the southwestern part of the 200 West Area (see Figure 9). The ditch was originally used to transport liquid effluent to U Pond. In 1985, a portion of the ditch between the 207-U Retention Basin and 242-S Evaporator was activated to receive steam condensate waste, chemical sewer waste, and cooling water from the UO_3 Plant (224-U Building) and U Plant and nonprocess effluent from the 242-S Evaporator. The stream from the UO_3 Plant contains low concentrations of uranium. In 1988, a total of 7.58 x 10^7 gal (2.87 x 10^8 L) of effluent were discharged to the ditch.

Wells 299-W19-21 and 299-W19-27 monitor the ditch (see Appendix A, Figure A-22). Concentrations of all analyzed constituents are below control standards and are stable or decreasing.

4.2.3.4 216-U-17 Crib. The 216-U-17 Crib is located east of the UO_3 Plant in the southeastern part of the 200 West Area (see Figure 9). The crib was constructed in 1987 as a replacement for the 216-U-12 Crib and began receiving effluent in February 1988. The crib receives process condensate from the UO_3 Plant, primarily during processing campaigns that normally run for about 2 wk. One campaign was run in 1988 and the total discharge to the crib was only 1.91×10^5 gal (7.22×10^5 L) in 1988. The waste stream contains moderate amounts of uranium.

Six wells, 299-W19-19, 299-W19-20, and 299-W19-23 through 299-W19-26 (see Appendix A, Figure A-23), monitor the upgradient (western) and downgradient (eastern) side of the crib. Elevated concentrations of uranium, ^{99}Tc, and nitrate have been observed in all of these wells since monitoring began in 1986 (for 299-W19-20) and 1987 (for the other wells). Carbon tetrachloride, fluoride, and specific conductance have also been consistently high in the two wells where these constituents are sampled (299-W19-20 and 299-W19-24). Several other contaminants have been observed at elevated levels, including magnesium, zinc, barium, and calcium, though only one sample for 1988 was analyzed for each of these chemicals. During 1988, uranium, ^{99}Tc, nitrate, and specific conductance were above the control standards and carbon tetrachloride was above drinking water standards.

Concentrations of uranium, ^{99}Tc, and nitrate increased in at least one monitoring well during 1988. Carbon tetrachloride and fluoride concentrations and specific conductance, measured in only two of the six wells, remained constant or declined throughout the year. No consistent pattern of trends for uranium, ^{99}Tc, and nitrate among the six wells was observed. Uranium is stable or decreasing in all wells except 299-W19-26, where it is rising. Technetium-99 is increasing in the three northern wells and well 299-W19-26, while nitrate is decreasing in the upgradient wells and generally increasing in the downgradient wells.

Because elevated constituents were observed in the groundwater before 216-U-17 Crib began receiving effluent, the contamination originated elsewhere. The most likely sources of uranium, ^{99}Tc, and nitrate are the inactive 216-U-1,2 Cribs (Section 4.3.2.6) or the leaking effluent line to the inactive 216-U-8 and 216-U-12 Cribs. Both sites are upgradient of 216-U-17 Crib and received large quantities of uranium and nitrate. The carbon tetrachloride, part of an extensive plume in the 200 West Area (Section 4.3.2.8), is likely to have originated from several cribs near PFP. An investigation, which includes the drilling of new wells, is being conducted this year to determine the source of the contamination observed at the 216-U-17 Crib.

4.2.3.5 216-W-LWC Crib. The 216-W-LWC Crib is located in the east-central part of the 200 West Area (see Figure 9). Liquid waste generated from the washing of radiation-worker clothing in the laundry building (2427-W Building) has been disposed to the crib since 1981. The effluent has elevated levels of gross beta and nitrate. In 1988, about 3.70×10^6 gal (1.40×10^7 L) of effluent were discharged to the crib.

Well 299-W14-10 monitors the crib (see Appendix A, Figure A-24). The nitrate concentration in the well rose above the control standard after disposal to the crib began, peaking in 1983, and then declined until 1985. Since 1985, the concentration has been relatively stable, though still above the control standard. Effluent discharged to the crib, which no longer contains nitrate above the control standard (Jungfleisch 1988), should not result in further nitrate contamination of the groundwater. No other analyzed constituents exceed the control standards.

4.2.3.6 216-Z-20 Crib. The 216-Z-20 Crib is located south of PFP (234-5Z Building) in the west-central part of the 200 West Area (see Figure 9). Effluent containing minor amounts of plutonium is discharged from the 234-5Z Building (2904-ZA stream) and combines with a stream from the 231-Z Building before entering the crib. The crib has operated since 1981 and received 6.05×10^7 gal (2.29×10^8 L) of waste in 1988.

Wells 299-W18-17 and 299-W18-20 monitor the crib (see Appendix A, Figure A-25). No analyzed constituents exceeded the control standards during 1988. Two analyses for carbon tetrachloride in well 299-W18-17 yielded values of 22 and 180 p/b, both above the drinking water standard of 5 p/b. The carbon tetrachloride belongs to an extensive plume in the 200 West Area believed to originate from several nearby inactive cribs (Section 4.3.2.8).

4.2.3.7 200 West Area Tank Farms. The 200 West Area contains 86 underground storage tanks for the storage of high-level liquid and solid radioactive waste. The tanks are located in three groups of tank farms: the 241-S group (241-S, 241-SX, and 241-SY) in the southern part of the 200 West Area, the 241-T group (241-T, 241-TX, and 241-TY) northeast of the PFP (234-5Z Building), and the 241-U Tank Farm southeast of the PFP (see Figure 9). All are of single-shelled construction, except for three double-shelled tanks in the 241-SY Tank Farm. Based on liquid-level monitoring data, as many as 34 of the single-shelled tanks are believed to have leaked some of their contents into the ground (Thurman 1989). In addition to liquid-level surveillance, the tanks are monitored by a network of vadose-zone wells that are routinely logged with gross gamma detection probes. Geophysical logs indicate very little downward movement of contamination in the vadose zone. Groundwater monitoring beneath the tank farms currently is accomplished by using available wells in the vicinity of the tanks. Many of these wells were originally drilled to monitor liquid WDFs adjacent to the tank farms. Recently developed plans call for a significant improvement in the groundwater well coverage of the single-shelled tanks.

Though elevated levels of certain constituents have been detected in wells close to the 200 West Area tank farms, no groundwater contamination is currently attributed to leaks in the tanks. Wells monitoring the 241-S Tank Farm group are located within the tritium and ^{99}Tc plumes that resulted from disposal to the cribs that serviced Redox plant operations. A 5variety of elevated constituents found in the groundwater beneath the 241-T Tank Farm group, including carbon tetrachloride, nitrate, tritium, and ^{99}Tc, are present upgradient of the tanks and are believed to originate from the cribs near the PFP (Section 4.3.2.8).

4.2.3.8 218-W Low-Level Burial Grounds. Low-level burial grounds are located in the western part of the 200 West Area (see Figure 9). Groundwater monitoring of LLBGs in the 200 West Area is limited to parts of 218-W-3A, 218-W-3A-E, and 218-W-5 (WMA-3) and part of 218-W-4C (WMA-4) burial grounds. The LLBGs have received solid radioactive, transuranic, and radioactive-mixed waste since 1944 from facilities all over the Hanford Site. Currently, no hazardous waste is being buried in the LLBGs unless it is inseparable from a radioactive waste. The waste is typically buried within the top 50 ft (15 m) of soil with a minimum of 8 ft (2.4 m) of overlaying backfill.

Groundwater monitoring of WMA-3 and WMA-4 is provided by a RCRA compliance project that began sampling in 1988. Nineteen wells were drilled and are sampled for the project. A summary of the sampling results can be found in Fruland and Lundgren (1989). Nitrate and chromium concentrations were above control standards and carbon tetrachloride levels were above drinking water standards in wells at WMA-3 and WMA-4. Gross alpha, coliform bacteria, and trichloroethylene are also elevated in several WMA-4 wells.

4.2.4 300 Area Active Waste Disposal Facilities

The 300 Area has one active WDF, the process trenches, which are located in the northern part of the 300 Area (see Appendix A, Figure A-26). The site consists of two parallel trenches measuring about 1,500 ft (457 m) long, 30 ft (9 m) wide, and 10 ft (3 m) deep. Discharged liquid waste is cycled between the two trenches with only one trench receiving waste at a time. The trenches have operated since 1975 and currently receive about 5.3×10^8 gal (2.0×10^9 L) of effluent per year. The waste consists primarily of cooling water from various facilities in the 300 Area. The Fuel Fabrication Facility contributed cooling water to the stream until its closure in 1987. A number of potentially hazardous chemicals were disposed to the trenches before the implementation of administrative controls in 1985. Uranium was also discharged when the Fuel Fabrication Facility was in operation.

The process trenches have been the subject of a RCRA assessment project since 1985. At the end of 1988, 27 wells were in the monitoring network (see Appendix A, Figure A-26). Results of groundwater sampling are summarized in Fruland and Lundgren (1989). Uranium is the most widespread contaminant occurring at levels greater than control standards in eight wells. The highest uranium concentrations are found close to the trenches in wells 3-1-17A and 3-1-19. Trichloroethane is above drinking water standards in two wells, 3-1-16B and 3-1-16C, which monitor the lower part of the unconfined aquifer and the uppermost confined aquifer, respectively. Other organic chemicals have also been detected in the groundwater, including dichlorethene, perchlorethene, chloroform, and carbon tetrachloride.

4.2.5 400 Area Active Waste Disposal Facilities

No radioactive or hazardous waste streams are discharged to the soil in the 400 Area. Waste disposal activities include low volumes of uncontaminated air-conditioning cooling water, which are discharged to the 400 Area process pond, and uncontaminated sump water that is periodically disposed into five shallow [<5-ft (<1.5-m) deep] dry wells. The seven wells sampled within the 400 Area are used by PNL primarily to monitor the passage of tritium and nitrate plumes generated in the 200 Areas. All nitrate concentrations are below drinking water standards and show no trend. Several wells have tritium concentrations above the drinking water standard, though concentrations are decreasing. Sanitary and drinking water wells within the 400 Area draw water from a deeper part of the unconfined aquifer where tritium levels are below the drinking water standard.

4.2.6 600 Area Active Waste Disposal Facilities

The Solid Waste Landfill (SWL) is the only active WDF in the 600 Area (aside from those immediately outside the 200 Areas and included in Sections 4.2.2 and 4.2.3). The landfill is located close to the center of the Hanford Site, approximately 3 mi (4.8 km) southeast of the 200 East Area. The 60-acre (24-ha) site consists of shallow, unlined burial trenches. The site has received nonradioactive solid waste generated throughout the Hanford Site including hazardous substances such as asbestos since 1973. Quantities of liquids containing solvents were disposed of in the past, but this is not current practice.

A RCRA compliance monitoring network covers the SWL and the adjacent inactive Nonradioactive Dangerous Waste (NRDW) landfill. Seven wells monitor the SWL with an additional seven at the NRDW landfill. Results of the monitoring are presented in Fruland and Lundgren (1989). Detectable levels of trichloroethylene have been observed in several downgradient wells. The landfill is in the path of the tritium and nitrate plumes originating from the 200 East Area (Sections 4.4.2 and 4.4.3) resulting in elevated levels of these constituents in the wells.

4.3 GROUNDWATER QUALITY AT INACTIVE WASTE DISPOSAL FACILITIES

The quality of groundwater beneath selected inactive WDFs is monitored. An inactive facility is no longer able to receive waste and may be in some stage of decommissioning. Inactive facilities exist throughout the Hanford Site and more than 600 sites have been evaluated for CERCLA investigation to date (Stenner et al. 1988). This section discusses selected inactive WDFs in the 100, 200, 300, and 1100 Areas which have had an impact on the groundwater beneath them. Appendix A contains well location maps for most of the facilities described in this section. Although control standards do not apply for groundwater contamination levels beneath inactive WDFs, the standards described in Chapter 2.0 are applied here for reference purposes. Appendix B contains a tabulation of the data collected for the OGWMN only, though additional data collected for other groundwater monitoring programs are the basis for some of the following discussions.

4.3.1 100 Area Inactive Waste Disposal Facilities

Groundwater contamination beneath inactive WDFs in the 100 Areas has been detected at three sites: the 183-H Solar Evaporation Basins in the 100-H Area, the 116-KE-1 Crib in the 100-K Area, and the 1301-N Liquid WDF in the 100-N Area. The sites in the 100-H and 100-N Areas are the subjects of RCRA groundwater monitoring projects.

4.3.1.1 183-H Solar Evaporation Basins. The 183-H Solar Evaporation Basins are located north of the H Reactor building in 100-H Area (see Appendix A, Figure A-1). The basins were originally used for the treatment of cooling water for the reactor, but beginning in 1973 they were used for storage and evaporation of various liquid chemical wastes from elsewhere on the Hanford Site. A leak in one of the basins was detected in 1977 so the liquid remaining in the leaking basin was transferred to the adjacent basins. Contamination of the groundwater occurred as a result of this leak.

Since 1985, a RCRA assessment-level monitoring network has been in place to characterize the groundwater contamination beneath the 183-H Solar Evaporation Basins with a total of 23 wells sampled in 1988. Details of the activities and results of this monitoring are presented in Fruland and Lundgren (1989). The primary contaminants found in the groundwater are chromium, nitrate, and uranium, which are above control standards, as well as sodium and ^{99}Tc, which are elevated. The concentrations of these constituents in wells near the Columbia River fluctuate with the river stage due to bank storage effects, but are generally decreasing.

4.3.1.2 116-KE-1 Crib. The 116-KE-1 Crib (also known as the 115-KE Crib) is located just east of the KE Reactor in 100-K Area (see Appendix A, Figure A-2). The crib serviced the reactor, receiving moderate quantities of tritium, until the reactor was closed in 1971 (Perkins 1988). Elevated levels of tritium have been detected in one of the four wells (199-K-30) that monitor the crib since sampling began in 1981. The tritium levels have fluctuated but have remained below the DCG. Nitrate concentrations are also elevated with levels in one well above the control standards.

4.3.1.3 1301-N Waste Disposal Facility. The 1301-N WDF is located just east of N Reactor in the 100-N Area (see Appendix A, Figure A-3). The facility consisted of a percolation basin connected to a 1,600-ft (487-m) long overflow ditch. Liquid waste from N Reactor was discharged to the WDF from reactor startup in 1963 until 1985. The effluent contained relatively high concentrations of radionuclides including ^{60}Co, ^{90}Sr, and ^{137}Cs.

A RCRA compliance monitoring network, which currently consists of seven wells (see Appendix A, Figure A-3), was established in 1987, though the groundwater had been monitored for radionuclide content before that time. Details of the RCRA monitoring activities and results are presented in Fruland and Lundgren (1989). The December 1988 specific-conductance reading in one of the monitoring wells, 1-N-3, was statistically higher than the established background level of this constituent, and assessment monitoring of the 1301-N WDF was initiated. Calcium and sulfate most likely account for the elevated specific-conductance reading. Other elevated readings found in the groundwater beneath the site include ^{90}Sr, which is as high as 13,800 pCi/L in well 1-N-67 and over 1,000 pCi/L in wells 1-N-2, 1-N-3, and 1-N-14. Tritium concentrations are above drinking water standards in several wells. Previously increasing trends in the concentrations of both ^{90}Sr and tritium leveled off during 1988. Several hazardous chemicals have been detected in well 1-N-2 including acetone, ethyl benzene, and xylene.

4.3.2 200 Area Inactive Waste Disposal Facilities

A number of inactive WDFs in the 200 Areas have resulted in groundwater contamination that exceeds the control standards. In the 200 East Area, these sites include the 216-A-10 Crib, 216-A-36B Crib, BY Cribs, 216-A-25 Pond, and 216-B-5 Reverse Well. In the 200 West Area, significant inactive sites include the 216-U-1/2 Cribs and the 216-U-10 Pond. Additionally, there is contamination beneath the cribs associated with T Plant and the PFP that has not been traced to specific WDFs.

4.3.2.1 216-A-10 Crib. The 216-A-10 Crib is located south of the PUREX Plant in the 200 East Area (see Figure 4). The crib began operating in 1956 and received process condensate waste from PUREX until it was replaced by the 216-A-45 Crib in 1987. The waste inventory included over 23,000 Ci of tritium, 140 Ci of ^{90}Sr, and 130 Ci of ^{137}Cs (Aldrich 1987). In addition to the two existing monitoring wells used by the OGWMN, 299-E17-1 and 299-E24-2, six new wells (see Appendix A, Figure A-6) were drilled and sampled as part of the 216-A-10 RCRA compliance project in 1988 (Fruland and Lundgren 1989).

The groundwater beneath the crib has elevated concentrations of tritium, ^{129}I, and nitrate. Levels of tritium and nitrate rose following the restart of PUREX operations in 1983 but have begun to decline since the crib was shut down in 1987 (Figure 11). The concentration of ^{129}I and nitrate are still above control standards while tritium continues to exceed the DCG.

Past tritium disposal to the 216-A-10 Crib and its predecessor, the 216-A-5 Crib, is believed to be responsible for a tritium plume that has reached the Columbia River east of the 200 Areas (DOE 1983). However, increasing concentrations of tritium (Figure 12) in two wells northwest of the crib, 299-E24-7 and 299-E23-1 (see Appendix A, Figure A-4), suggest the possibility that some of the contamination is moving to the northwest. The groundwater gradient in this portion of the 200 East Area is too flat to determine a direction with confidence and additional investigation is required to confirm this hypothesis.

4.3.2.2 216-A-36B Crib. The 216-A-36B Crib is located south of the PUREX Plant in the 200 East Area (see Figure 4). The crib was used between 1966 and 1972 and again from 1982 to 1987. During the latter period, the crib received the ammonia scrubber waste (ASD stream) from PUREX, which contained substantial quantities of ^{90}Sr and ^{106}Ru. The crib was deactivated in 1987 after excessive quantities of ammonium hydroxide were detected in the stream (Buelt et al. 1988). Two wells, 299-E17-5 and 299-E17-9, monitored the facility until last year when five additional wells (see Appendix A, Figure A-9) were drilled as part of the 216-A-36B RCRA compliance project (Fruland and Lundgren 1989).

Wells monitoring the crib have concentrations of nitrate above the control standard and levels of tritium greater than the DCG. Several wells also have detectable concentrations of ^{106}Ru and ^{129}I. The proximity of this crib to the 216-A-10 Crib makes it difficult to determine which WDF produced the contamination. However, tritium is most likely from the inactive 216-A-10 Crib since concentrations in well 299-E17-5 began declining soon after the crib was deactivated in early 1987 and before 216-A-36B was shut down in mid-1987 (Figure 13). The ^{106}Ru probably originated from the 216-A-36B Crib because it was found predominantly in the ASD stream.

Figure 11. Tritium and Nitrate Concentration Histories of Well 299-E24-2 at the Inactive 216-A-10 Crib.

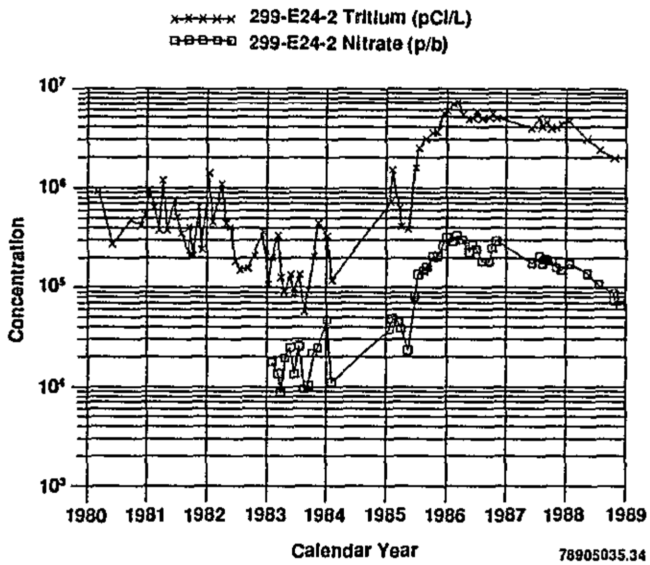


Figure 12. Tritium Concentration Histories of Wells 299-E23-1 and 299-E24-7 Northwest of the Plutonium-Uranium Extraction Plant.

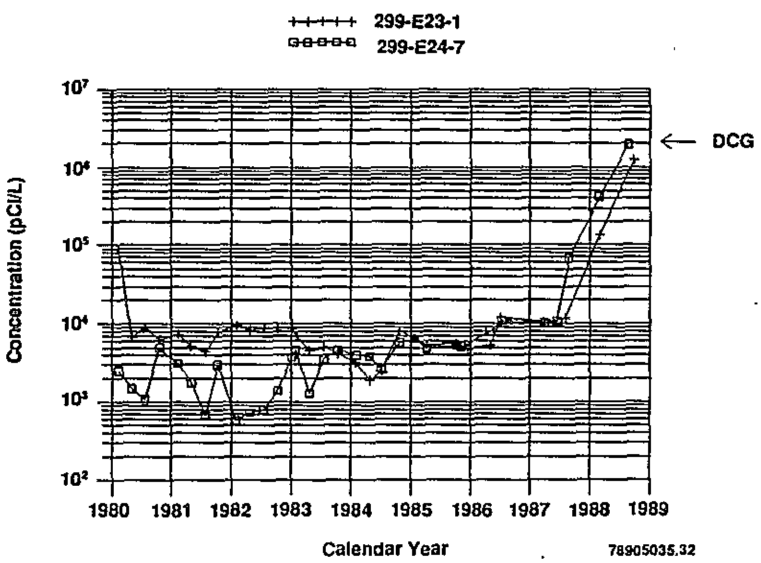
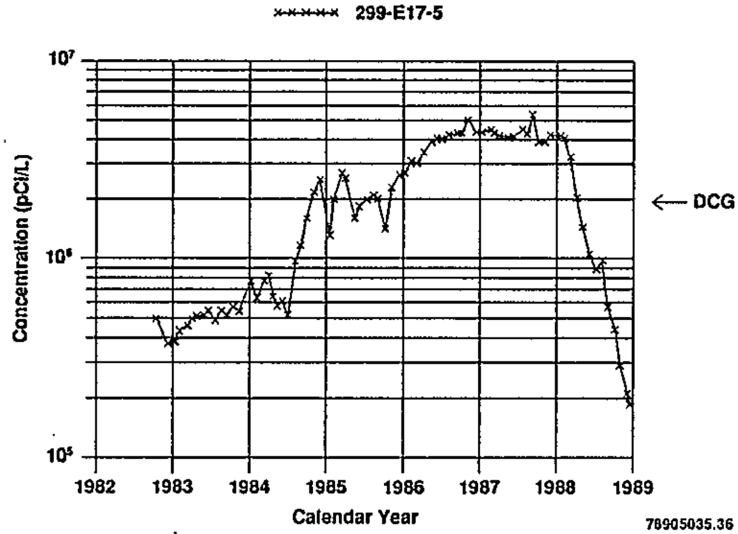


Figure 13. Tritium Concentration History of Well 299-E17-5 at the Inactive 216-A-36B Crib.

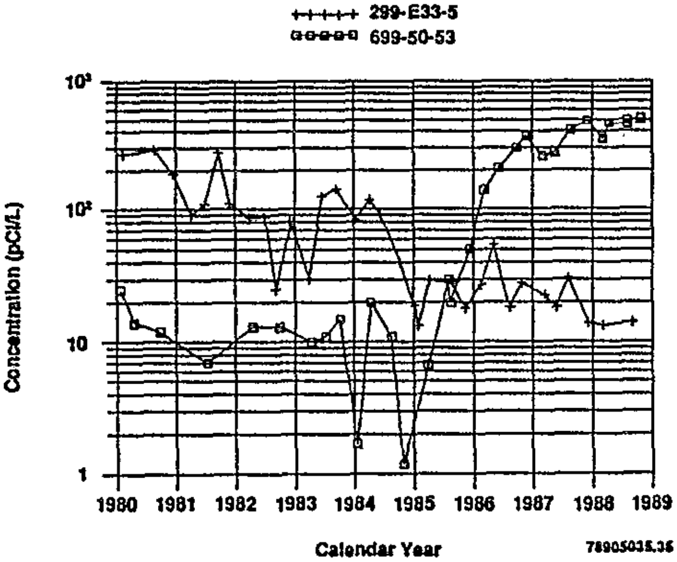


4.3.2.3 BY Cribs. The group of eight cribs (216-B-43 through 216-B-50) located at the northern border of the 200 East Area adjacent to the 241-BY Tank Farm (see Figure 4) are referred to as the BY Cribs. The BY Cribs operated briefly during the late 1950s to receive supernatant generated during uranium recovery from the 241-BY tank waste. The supernatant resulted from the precipitation of cesium using potassium ferrocyanide.

Groundwater contamination resulting from disposal to the BY Cribs continues to be detected in monitoring wells. The contaminants have moved north with the groundwater to form a plume that extends at least 1/2 mi (0.80 km) beyond the northern boundary of the 200 East Area (Section 4.4.1). The primary constituents of the plume include ^{60}Co, ^{99}Tc, and cyanide. Though ^{60}Co is not normally mobile in the groundwater, it has apparently complexed with cyanide to form a more mobile compound (Evans et al. 1988). Concentrations of these constituents are highest, and still increasing, in a well monitored by PNL (699-50-53) about 1/2 mi (0.80 km) north of the BY Cribs. Figure 14 compares the increasing ^{60}Co concentrations in this downgradient well with the declining readings in a well closer to the BY Cribs (299-E33-5) indicating movement of the plume. Concentrations of ^{60}Co and ^{99}Tc in well 699-50-53 both exceed their control standards.

4.3.2.4 216-A-25 Pond. The 216-A-25 Pond, also known as Gable Mountain Pond, was located approximately 1 mi (1.6 km) north of the 200 East Area (see Appendix A, Figure A-7). The pond became active in 1957 and received cooling water streams from various 200 East Area facilities. In 1987, the pond was deactivated and backfilled. Although the effluent sent to the pond was generally low level, in 1964 an estimated 7,500 Ci of radionuclides spilled into the pond when a cooling coil ruptured in the PUREX Plant. With the exception of ^{90}Sr the radionuclides were short lived. Increases in ^{90}Sr concentration in well 699-53-47A prompted an investigation in 1984 (Law et al.

Figure 14. Cobalt-60 Concentration Histories of Well 299-E33-5 and Well 699-50-53 North of the BY Cribs.



1984) and additional monitoring wells were installed. The investigaiton concluded that the ^{90}Sr the plume was localized and its movement so slow as to have no significant impact at the Hanford Site boundary.

Concentration of ^{90}Sr have remained stable during 1988 in all monitoring wells except 699-53-48A, where levels increased from below detection (5 pCi/L) to more than 50 pCi/L. However, this is still considerably below the concentration in its companion well 699-53-48B, located several feet away. The historically low concentrations in well 699-53-48A can be attributed to the fact that the well is completed in the basalt at the bottom of the 7-ft- (2-m-) thick unconfined aquifer while the contamination was probably located near the top of the aquifer. The average 1988 concentrations of ^{90}Sr at monitoring wells along the former bank of Gable Mountain Pond range from 366 pCi/L in well 699-53-48B down to below detection at well 699-55-50C (see Appendix A, Figure A-7 for well locations).

4.3.2.5 216-B-5 Reverse Well. The 216-B-5 Reverse Well is located northeast of B Plant (221-B Building) in the 200 East Area (see Figure 4). The reverse well was drilled to the water table. From 1945 to 1947, waste containing ^{90}Sr, ^{137}Cs, and plutonium was pumped directly into the unconfined aquifer. A characterization study (Smith 1980) determined that most of the radioactive contaminants were relatively immobile in the groundwater and had remained within 40 ft (12 m) of the reverse well.

Four groundwater monitoring wells are located within about 50 ft (15 m) of the reverse well: 299-E28-7, 299-E28-23, 299-E28-24, and 299-E28-25 (see Appendix A, Figure A-14). Elevated readings of ^{90}Sr, ^{137}Cs, and plutonium continue to be observed. Average concentrations of ^{90}Sr are stable and range from 68 pCi/L in 299-E28-7 to 5240 pCi/L in 299-E28-25. Plutonium is above control standards in 299-E28-23 and 2-E28-25 but concentrations remain stable. Cesium-137 levels are above control standards, but decreasing, only in the well closest to the reverse well though it is also detected in 299-E28-25.

4.3.2.6 216-U-1/2 Cribs. The 216-U-1/2 Cribs are located southwest of U Plant (221-U Building) in the southcentral part of the 200 West Area (see Figure 9). These cribs received waste with large quantities of uranium and nitrate from U and UO_3 Plants between 1952 and 1967. Abrupt increases in uranium concentrations in one of the monitoring wells near the cribs were observed in 1985. Subsequent investigation revealed that the contamination had entered the aquifer by draining down the outside of three wells. Liquids disposed to the nearby 216-U-16 Crib provided a driving force to drive weakly-sorbed waste beneath the 216-U-1/2 Cribs to the water table. Discharge to 216-U-16 ceased, the leaky wells were sealed, and several additional monitoring wells were drilled in 1985. Groundwater concentrations of uranium, which had peaked at 72,000 pCi/L, were reduced by pumping the groundwater and treating it with an ion-exchange process.

The seven wells which monitor the inactive cribs (see Appendix A, Figure A-20) continued to show elevated concentrations of uranium, ^{99}Tc, ^{129}I, carbon tetrachloride, and nitrate in 1988. Uranium concentrations tend to be highest in well 299-W19-3 while ^{99}Tc and nitrate are highest in well 299-W19-18. Both of these wells are downgradient (east) of the cribs suggesting movement of the plume. Plume movement is also indicated by the decreasing concentrations of uranium, ^{99}Tc, and nitrate in all wells. Carbon tetrachloride, however, is increasing slightly in all wells sampled for this constituent and the highest values are in three wells on the northwestern side of the site. This pattern suggests the slow arrival of a plume from the northwest and supports the belief that carbon tetrachloride in the groundwater of the 200 West Area originates near PFP (Section 4.3.2.8).

4.3.2.7 216-U-10 Pond. The 216-U-10 Pond (or U Pond) was located in the southwest corner of the 200 West Area (see Figure 9). The pond was deactivated in 1984 after 40 yr of operation and about 4.33×10^{10} gal (1.64×10^{11} L) of influent. Though the pond received a moderate quantity of contaminants, including uranium, its most obvious effect on the aquifer has been the creation of a groundwater mound (see Section 4.1) that controls the groundwater gradient in the 200 West Area.

The three closest wells monitoring the pond site, 299-W18-15, 299-W23-11, and 699-35-78A (see Appendix A, Figure A-21) continue to show uranium concentrations close to or above the control standard. One well, 299-W18-15, also contains carbon tetrachloride at levels above the drinking water standard. Concentrations remained stable except for uranium in 699-35-78A, which rose from 10 to about 20 pCi/L during 1988.

4.3.2.8 216-Z Cribs. A number of cribs, which serviced operations at the PFP (234-5Z Building) in the 200 West Area (see Figure 9), were used to dispose of chemicals that now appear in the groundwater. A variety of chemicals were used at the PFP in the production of plutonium nitrate and were present in the waste streams discharged to several 216-Z Cribs. Stenner et al. (1988) report that 2.6×10^5 kg of carbon tetrachloride were disposed to the 216-Z-18 Crib alone between 1969 and 1973. Groundwater contamination appears to have moved north from the PFP and mixed with contamination resulting from disposal to the 216-T Cribs. The T Cribs were used to dispose of T Plant (202-T Building) bismuth-phosphate separations waste generated between 1944 and 1956 and also received supernatant waste from single-shelled tank scavenging activities in the late 1950s.

The combined area of groundwater contamination resulting from disposal to the 216-Z and 216-T Cribs extends from the PFP to the northern border of the 200 West Area. More than 30 wells in this area are sampled for hazardous chemicals by the LLBG RCRA project and by the PNL Hanford Site network. Additional wells are also sampled for radionuclides by the OGWMN at specific cribs and tank farms. Groundwater contaminants found in these wells include carbon tetrachloride, fluoride, nitrate, ^{99}Tc, and tritium. All of these constituents, except ^{99}Tc are above drinking water standards (and control standards for nitrate and fluoride) in some of the wells. Carbon tetrachloride, the most widespread of the contaminants, is present in most wells of central and northern parts of the 200 West Area. The highest concentrations, averaging up to 8,100 p/b at well 299-W15-16, are found near the PFP. The extents of ^{99}Tc (as reflected by gross beta), tritium, and nitrate plumes are described in Sections 4.4.1, 4.4.2, and 4.4.3, respectively. Fluoride contamination above the control standard is present in five wells close to the 241-T and 241-TX Tank Farms. Tritium and nitrate concentrations do not show any significant trends, while data collection for the other constituents generally was begun too recently to determine a pattern.

4.3.3 300 Area Inactive Waste Disposal Facilities

Numerous inactive facilities exist in the 300 Area. However, no single inactive site has been identified as a source of groundwater contamination that is present beneath the 300 Area. The monitoring network established for the process trenches (see Section 4.2.4) encompasses much of the 300 Area and provides partial coverage of inactive facilities. Most of the observed contamination is attributed to past disposal to the process trenches.

4.3.4 1100 Area Inactive Waste Disposal Facilities

The 1100 Area is located just north of the city of Richland (see Figure 1) and serves as a maintenance facility for Hanford Site operations. Several liquid and solid WDFs were active between 1950 and 1985. During 1988, five monitoring wells were installed approximately 2,000 ft (610 m) east of the disposal sites and just upgradient of the city of Richland recharge area and well field. The purpose of the wells was to ensure that there was no contamination from DOE operations or any other upgradient source.

Results of sampling of the five wells indicate that all constituents are below drinking water standards, and most constituents are below detection limits. Sampling of these wells will continue in 1989.

4.4 CONTAMINATION PLUMES

Contamination plume maps have been prepared for three screening parameters in the groundwater beneath the 200 Areas (Figures 15, 16, and 17). Similar maps for contaminants at the other operational areas can be found in

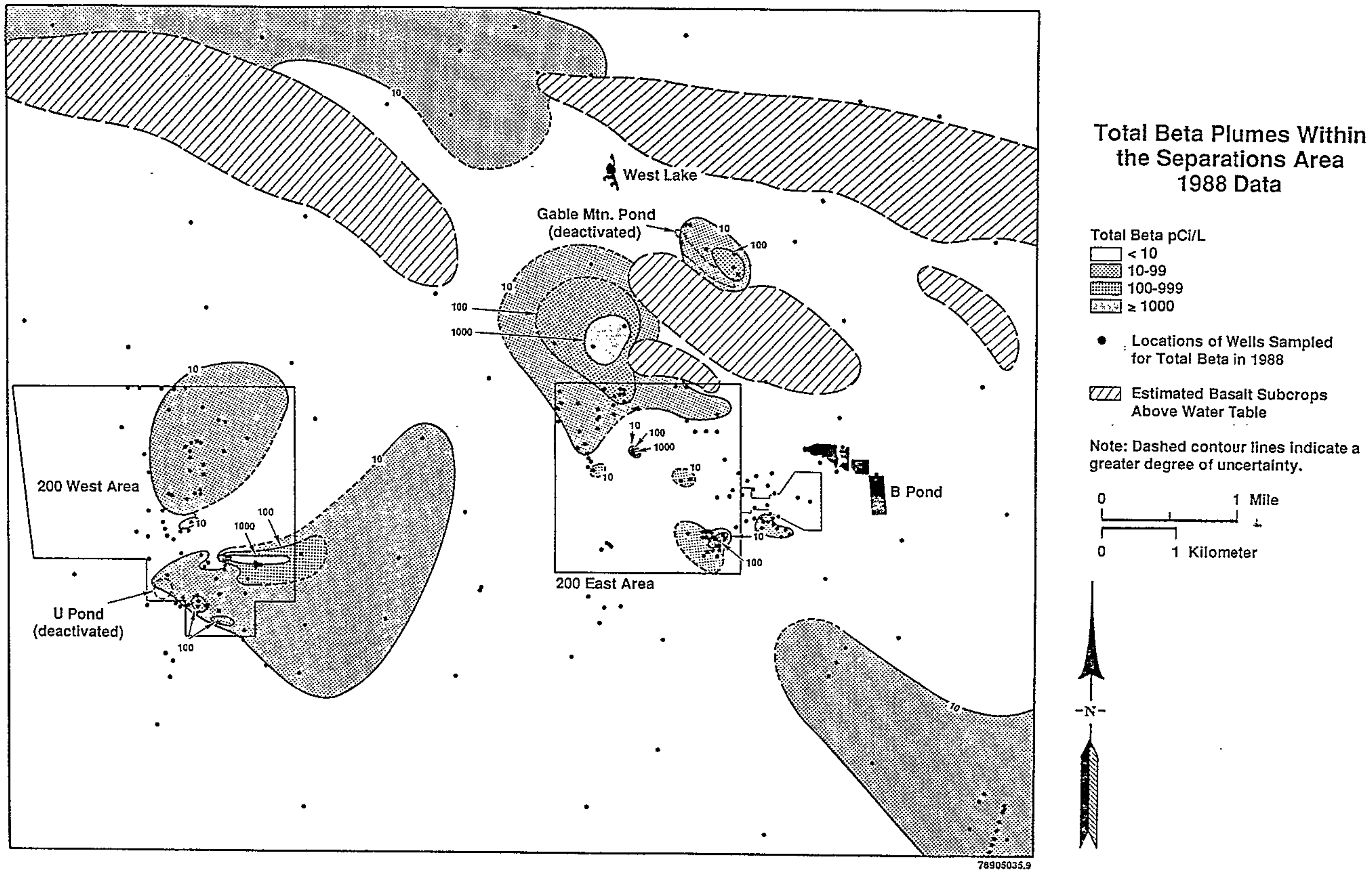


Figure 15. Gross Beta Plume Map for the 200 Areas, 1988.

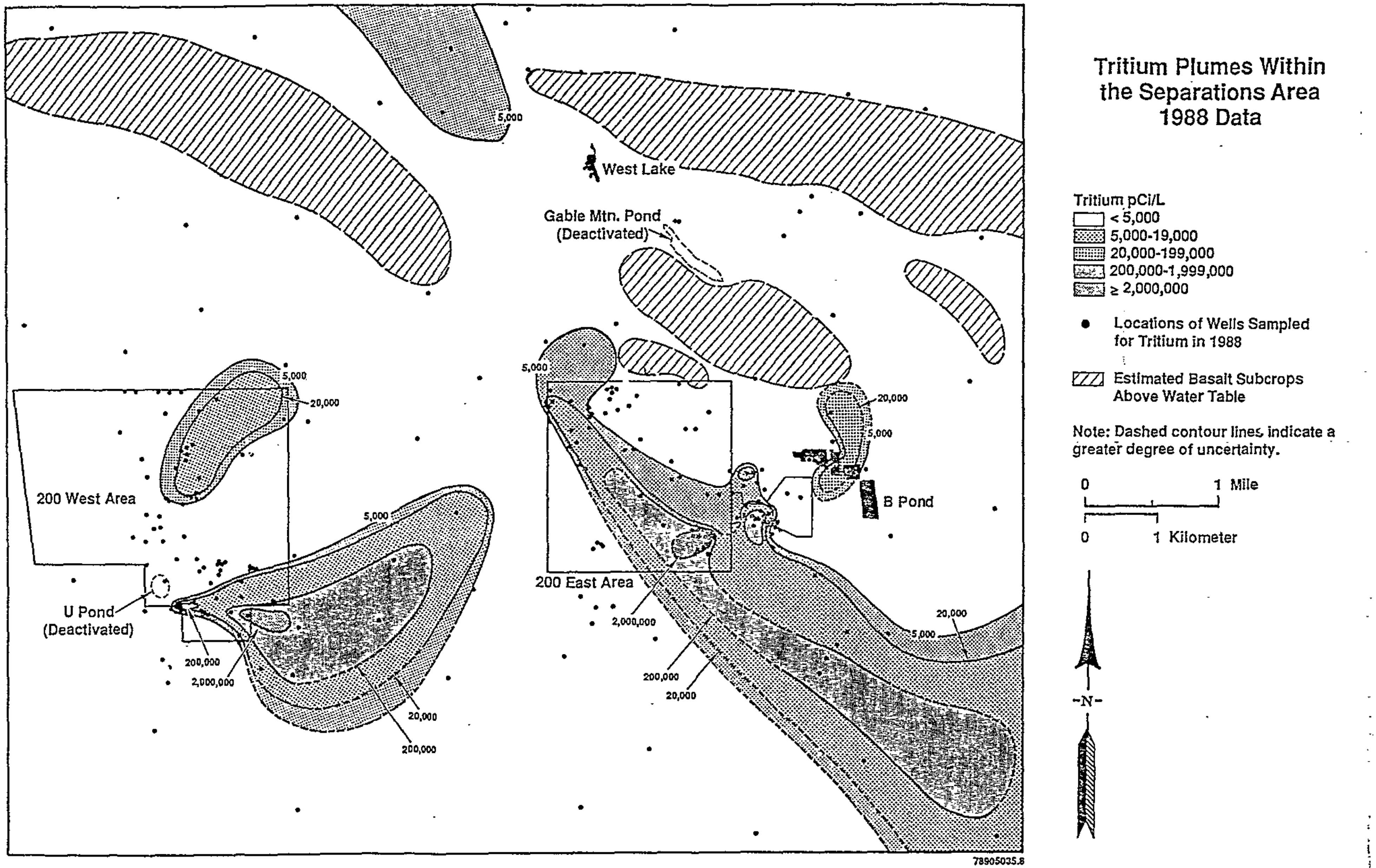


Figure 16. Tritium Plume Map for the 200 Areas, 1988.

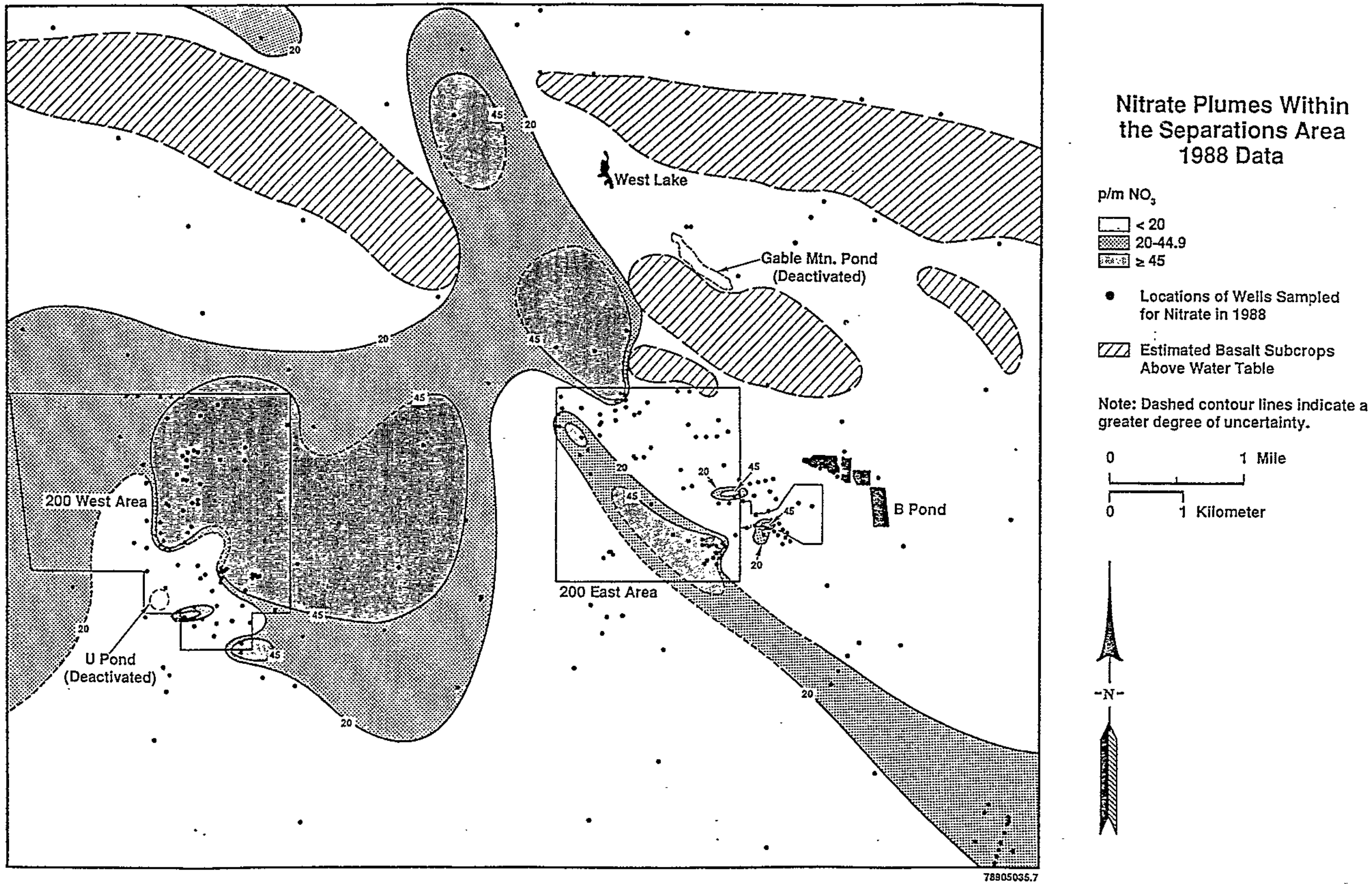


Figure 17. Nitrate Plume Map for the 200 Areas, 1988.

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Jaquish and Bryce (1989), which describes the PNL Hanford Site monitoring program. The mapped parameters are gross beta, tritium, and nitrate. These constituents are used because they are present in many Hanford Site waste streams and in much of the groundwater beneath the 200 Areas. Tritium and nitrate are especially useful in illustrating the maximum extents of contamination since they move freely with the groundwater, unlike most radionuclides that tend to travel more slowly due to their being sorbed on the sediments.

The following plume maps were constructed using 1988 annual average values from each well in the map area open to the top of the unconfined aquifer with data for that constituent. Although a large number of wells are used to produce the maps, caution must be exercised when examining these maps, as with any interpreted contour map. The density of wells available for contouring varies with the position as does the number of values used to compute each average. As a result, the confidence in the positions of the contour lines is highly variable. The contours with greatest uncertainty are dashed on the maps. Concentration values from several wells that had anomalously low readings and which sample large intervals of the aquifer (which could result in a dilute sample) were not incorporated in the maps. Wells with unusually high average readings were not discarded. Single "flier" values that raised an overall average to an anomalous level were discarded in the computation of the plotted average.

4.4.1 Gross Beta

Beta radiation in groundwater samples can be attributed to the presence of ^{60}Co, ^{90}Sr, ^{99}Tc, ^{106}Ru, ^{137}Cs, and ^{234}Th (a uranium daughter). The gross beta map for the 200 Areas (see Figure 15) shows the 10-, 100-, and 1,000-pCi/L isopleths. The detection limit for the gross beta analysis used is 8 pCi/L. This detection limit is below those for ^{60}Co, ^{99}Tc, ^{106}Ru, and ^{137}Cs. Therefore, beta readings below about 100 pCi/L often reflect the presence of an isotope which is still below its detection limit, making the specific radionuclide difficult to identify.

A number of beta plumes exist in the 200 East Area and vicinity, which are almost all caused by discontinued waste disposal activities. The highest gross beta values occur at the 216-B-5 Reverse Well (see Section 4.3.2.5) where there is very localized ^{90}Sr and ^{137}Cs contamination. The large plume north of the 200 East Area contains ^{60}Co and ^{99}Tc from the BY Cribs (see Section 4.3.2.3), with the latter isotope responsible for the majority of the activity. Relatively low levels of beta are also observed emanating from the cribs south of PUREX, where ^{106}Ru from the recently deactivated 216-A-36B Crib has been identified as the probable beta source (see Section 4.3.2.2). The plume around the Gable Mountain Pond site results from ^{90}Sr contamination that occurred in 1964 (see Section 4.3.2.4). The small plume issuing from the vicinity of the 216-A-37-1 Crib appears to be related to current activities there which include disposal of detectable levels of fission products (see Section 4.2.2.3). This and other lower-level plumes around the 200 East Area have not been attributed to specific radionuclides.

Two plumes are depicted in the 200 West Area. The dashed contour lines reflect the poor well coverage that exists between the plumes. The plume in the southern part of the 200 West Area, moving east and northeast, has several probable sources. The highest concentrations, exceeding 1,000 pCi/L, result from ^{99}Tc and uranium contamination around the 216-U-1,2 and 216-U-17 Cribs (see Sections 4.3.2.6 and 4.2.3.4). This contamination was recently mobilized and is probably not related to the elevated levels observed extending out east of the 200 West Area. The bulk of the southern plume is probably related to disposal of Redox waste to the 216-S Cribs during the 1950s and early 1960s. Except for ^{99}Tc around the 241-S Tank Farms and ^{90}Sr close to the 216-S-1,2 Cribs, no other specific radionuclides have been detected in this older plume. Uranium (reflected by its daughter ^{234}Th) may be responsible for elevated beta near the deactivated U Pond. The plume in the northern part of 200 West Area results from low-level ^{99}Tc contamination which may have resulted from past disposal to cribs near PFP and T Plant.

A comparison with gross beta plumes that were produced for 1987 data (Serkowski et al. 1988) reveals slight changes in the shapes of individual plumes but no significant differences. Most changes occurred where new wells, drilled for RCRA projects, improved coverage.

4.4.2 Tritium

Tritium concentrations in the 200 Areas and vicinity are contoured in Figure 16. Tritium isopleths for 5,000, 20,000 (drinking water standard), 200,000, and 2,000,000 (DCG) pCi/L are shown on the map. A Site-wide map of tritium, showing the extension of the 200 East Area plume to the Columbia River, is presented in Jaquish and Bryce (1989). The magnitudes and extents of the plumes in the 200 Areas are due to the relatively high tritium disposal concentrations coupled with the mobility of tritium in the groundwater. Current tritium disposal includes the PUREX process distillate going to the 216-A-45 Crib (effluent concentrations up to 1.3×10^8 pCi/L in 1988) and the 242-A Evaporator process condensate going to the 216-A-37-1 Crib (effluent concentrations up to 7.3×10^6 pCi/L).

In the 200 East Area, the effects of current and past tritium disposal to the cribs south of PUREX are the dominant feature. Tritium disposed to these cribs has historically moved southeast with the groundwater, forming an extensive plume that reaches the Columbia River. However, recent samples from wells northwest of PUREX show substantial tritium increases (see Figure 12) beginning in 1987. The magnitude of tritium concentrations in these wells (now approaching the DCG) suggests that the contamination originated from the PUREX cribs. A northwestward movement of the plume may not have been detected in the past due to (1) the poor well coverage in the central part of the 200 East Area, or (2) the nearly flat groundwater gradient which may have reversed in the last several years due to increases in disposal to B Pond and the deactivation of Gable Mountain Pond. Confirmation of this northwestwardly flow regime will require additional investigation. A minor contributor to the primary tritium plume is the 216-A-37-1 Crib, just east of the 200 East Area boundary. A small amount of tritium is also present in the groundwater beneath B Pond.

Two tritium plumes emanate from the 200 West Area. The large plume in the southern part reflects past disposal to the 216-S Cribs during the operation of the Redox facility. A minor plume is moving north from the area beneath the 216-T Cribs.

The most significant change in plume configurations since the 1987 tritium map (Serkowski et al. 1988) is the increased emphasis on the hypothesized northwestward movement of the plume generated by PUREX operations. This is primarily an interpretational change precipitated by the observation of concentration increases in only a few wells. The southeastern component of the plume has also been extended so that the 200,000 pCi/L isopleth nearly reaches the Central Landfill in the lower right-hand corner of the map. The 200 West Area plumes have not changed appreciably.

4.4.3 Nitrate

Nitrate is the most widely distributed contaminant in the groundwater beneath the Hanford Site. Many WDFs received chemicals that contribute to the nitrate levels in the groundwater including nitric acid and ammonium compounds, which can be transformed into nitrate in the soil. The extent of elevated nitrate concentrations in the groundwater beneath the 200 Areas is presented in Figure 17, where the 20 and 45 p/m isopleths are illustrated. The control standard and drinking water standard for nitrate is 45 p/m while the detection limit is 2.5 p/m or less.

Nitrate in the 200 East Area originates primarily from the 216-A Cribs which service PUREX operations, where nitric acid is used to dissolve fuel elements. A plume, similar in extent to the tritium plume, emanates from the cribs south of PUREX and has moved to the southeast and possibly to the northwest. The current direction of movement is presumed to be to the northwest, which is based on increases in nitrate concentrations in two wells northwest of PUREX. These increases are paralleled by similar increases in tritium (see Figure 12). Nitrate plumes in the 200 East Area are also associated with the BY Cribs, which are located in the northern part of the area (see Section 4.3.2.3) and the 216-A-37-1 Crib (see Section 4.2.2.3), which is located just east of the boundary.

In the 200 West Area, the sources of nitrate appear to be more diffuse. In the south, disposal to the 216-S-26 Crib (see Section 4.2.3.2) has contributed to a large plume that probably resulted from Redox operations in the past. Contamination at the 216-U-1,2 Cribs (see Section 4.3.2.6) includes a nitrate plume, which is spreading to the east. Various cribs near T Plant and PFP have contributed nitrate to the northern part of the 200 West Area. Operation of the 216-W-LWC Crib (see Section 4.2.3.5) has also added to the nitrate levels in the groundwater. Nitrate from these sources appears to have merged into the extensive plume over much of the 200 West Area. Not all of the nitrate may have originated from Hanford Site activities, however, because elevated nitrate levels are observed upgradient from the 200 West Area.

The primary difference between the 1988 nitrate map and the 1987 map (Serkowski et al. 1988) is in the interpretation of the plume emanating from the cribs south of the PUREX Plant. A northwestward, rather than southeastward, movement of the plume is now suspected. In general, however, nitrate levels have not changed significantly.

4.5 AQUIFER INTERCOMMUNICATION

The Elephant Mountain Member, which is the uppermost basalt flow in the Saddle Mountains Formation, serves as the bottom of parts of the unconfined aquifer and the confining layer of the underlying Rattlesnake Ridge interbed. This sedimentary interbed is considered to be the uppermost confined aquifer in the Separations Area (200 Areas and vicinity) at the Hanford Site.

A report (Graham et al. 1984) identifies areas of complete erosion of the Elephant Mountain basalt near West Lake and near well 699-54-47 and areas of suspected erosion near well 699-47-50 (Figure 18). A potential for downward migration of water from the unconfined aquifer to the confined aquifer, or aquifer intercommunication, exists if the water table of the unconfined aquifer is above the potentiometric surface of the confined aquifer in places where the confining stratum is permeable or missing.

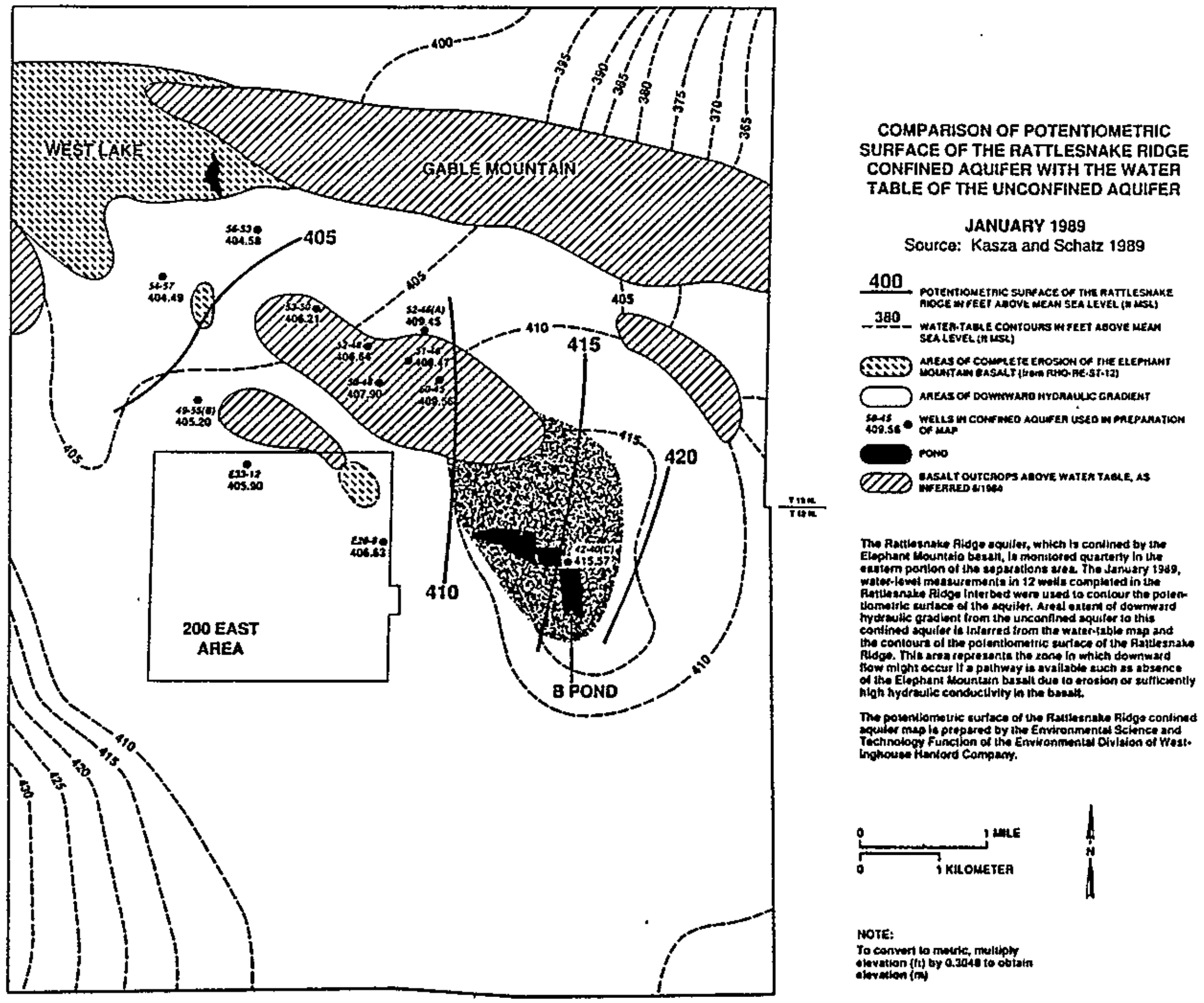
Aquifer intercommunication could result in contamination being introduced into the Rattlesnake Ridge confined aquifer. The report by Graham et al. (1984) concluded that a downward gradient in the eroded areas did not exist in June 1982.

Water level monitoring in the unconfined and confined aquifer continued in 1988, along with sample collection and analysis for the tracer constituents tritium and nitrate.

Results of the confined aquifer sampling program are given in Appendix B (Table B-4). Well locations are shown in Figure 18. Average nitrate levels are all below the detection limit of 2,500 p/b except for a value of 6,240 p/b in well 699-47-50. Nitrate has been detected in this well previously (Serkowski et al. 1988), but the concentration has remained relatively stable. Tritium concentrations are also mostly below the detection limit of 500 pCi/L, except in wells 699-42-40C and 699-52-46A. Well 699-52-46A has sporadically shown tritium readings above detection limit in the past but no discernible trend. However, well 699-42-40C has consistently exhibited detectable and increasing tritium concentrations. The contamination is likely due to localized leakage along the well casing, but could also result from aquifer intercommunication in the vicinity of B Pond.

A comparison between the water table of the unconfined aquifer and the potentiometric surface of the confined aquifer, based on January 1989 measurements (Kasza and Schatz 1989), is depicted in Figure 18. The area with a downward hydraulic gradient east of the 200 East Area is similar to that reported for December 1987 (Serkowski et al. 1988). Though the area of downward hydraulic gradient does not coincide with suspected areas of complete erosion of the Elephant Mountain Member, it does encompass the area around well 699-42-40C, where tritium has been detected in the confined aquifer.

Figure 18. Comparison of the Potentiometric Surface of the Rattlesnake Ridge Confined Aquifer with the Water Table of the Unconfined Aquifer, January 1989.



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APPENDIX A

WELL LOCATION MAPS

LIST OF FIGURES

A.1 WELL NUMBERING SYSTEM

A detailed description of the Hanford Site well numbering system is given in McGhan et al. (1985). Slightly different numbering systems are used, depending on the area in which the well is located. However, all well numbers use a three-part designation beginning with a three- or four-digit prefix of the form "X99-." The "X" corresponds to the Hanford Site area (i.e., 1 = 100 Area, 2 = 200 Area, 3 = 300 Area, 4 = 400 Area, 6 = 600 Area, 11 = 1100 Area, and 30 = 3000 Area) and the "99" identifies it as a well. The various schemes for each area are summarized below.

A.1.1 100 AND 200 AREA WELLS

Wells located in the 100 and 200 Areas are named using the form "X99-Ynn-N" (e.g., 299-E25-19). The "X" is a "1" for a 100 Area well and a "2" for a 200 Area well. The "Y" specifies the subarea in which the well is located (i.e., B = 100-B, D = 100-D, F = 100-F, H = 100-H, K = 100-K, N = 100-N, E = 200 East Area, and W = 200 West Area). The number "nn" is blank for 100 Area wells and for 200 Area wells is the map sheet on which the well is located as defined in McGhan et al. (1985). The final number "N" generally corresponds to the position of the well in the drilling sequence for wells in that map sheet. If "N" is less than 50, the well was drilled to the groundwater, otherwise it was a dry well. For example, well 299-E25-19 is the 19th well drilled to the groundwater in the area covered by map sheet 25 in 200 East Area.

A.1.2 300 AREA WELLS

Wells located in the 300 Area are named using the form "399-nn-N" (e.g., 3-2-1). The naming scheme is the same as in the 100 and 200 Areas except that no subarea letter is used.

A.1.3 400, 600, 1100, AND 3000 AREA WELLS

Wells located in the 400, 600, 1100, and 3000 Areas are named using the form "X99-N-W" (e.g., 699-53-48B). The "X" corresponds to the area as described above. The "N" and "W" are the north and west coordinates, respectively, of the well, rounded to the nearest thousand. Hanford plant coordinates are used for 400 and 600 Area wells, while Richland coordinates are generally used in the 1100 and 3000 Areas. Both of these coordinate systems use feet as the unit of measure. When more than one well has the same coordinate (rounded to a thousand), a letter is appended to the name. Wells located south or east of the coordinate origin (near the 400 Area for plant coordinates) have an "S" or an "E", respectively, preceding the coordinate. For example, well 699-53-48B is located in the 600 Area and has coordinates 52,868 ft north and 47,729 ft west.

A.2 DISPOSAL FACILITY NUMBERING SYSTEM

The naming convention for WDFs at the Hanford Site consists of a three-part designation, similar to that used for naming wells. A three-digit prefix designates the general location and type of the WDF: for example, "116-" identifies a liquid WDF in the 100 Area, "241-" is a tank in the 200 Area, and "318-" is a solid-waste burial ground in the 300 Area. The next part of the name is usually the operational zone with which the facility is associated. In the 100 Areas, the zones are the reactor letters: B, C, F, H, K, and N. The 200 Areas are segregated into the A, B, and C zones of the 200 East Area and the S, T, U, W, and Z zones of the 200 West Area. The final number in the three-part designation is the sequential construction order of the facility. Therefore, "216-A-45" is the forty-fifth liquid WDF in the A zone of 200 East Area. Some variations of this naming scheme exist and certain facilities are referred to by informal names (e.g., 1325-N) which do not follow this convention.

A.3 WELL LOCATION MAPS

Well location maps for the 100-H, 100-K, 100-N, 200 East, 200 West, and 300 Areas are shown in Figures A-1 through A-27.

A.4 REFERENCE

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Figure A-1. Site Map of 183-H Solar Evaporation Basins Showing Well Locations.

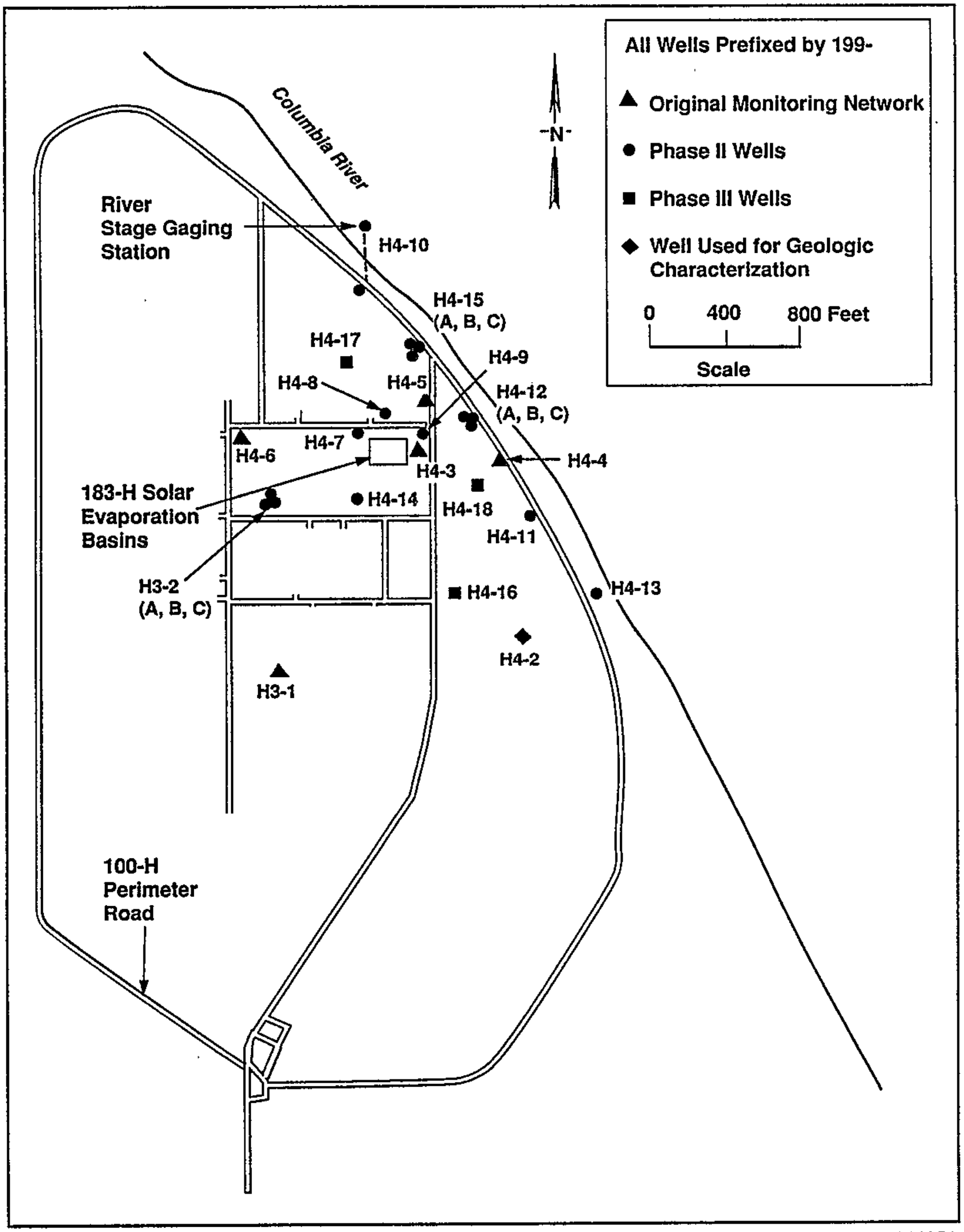

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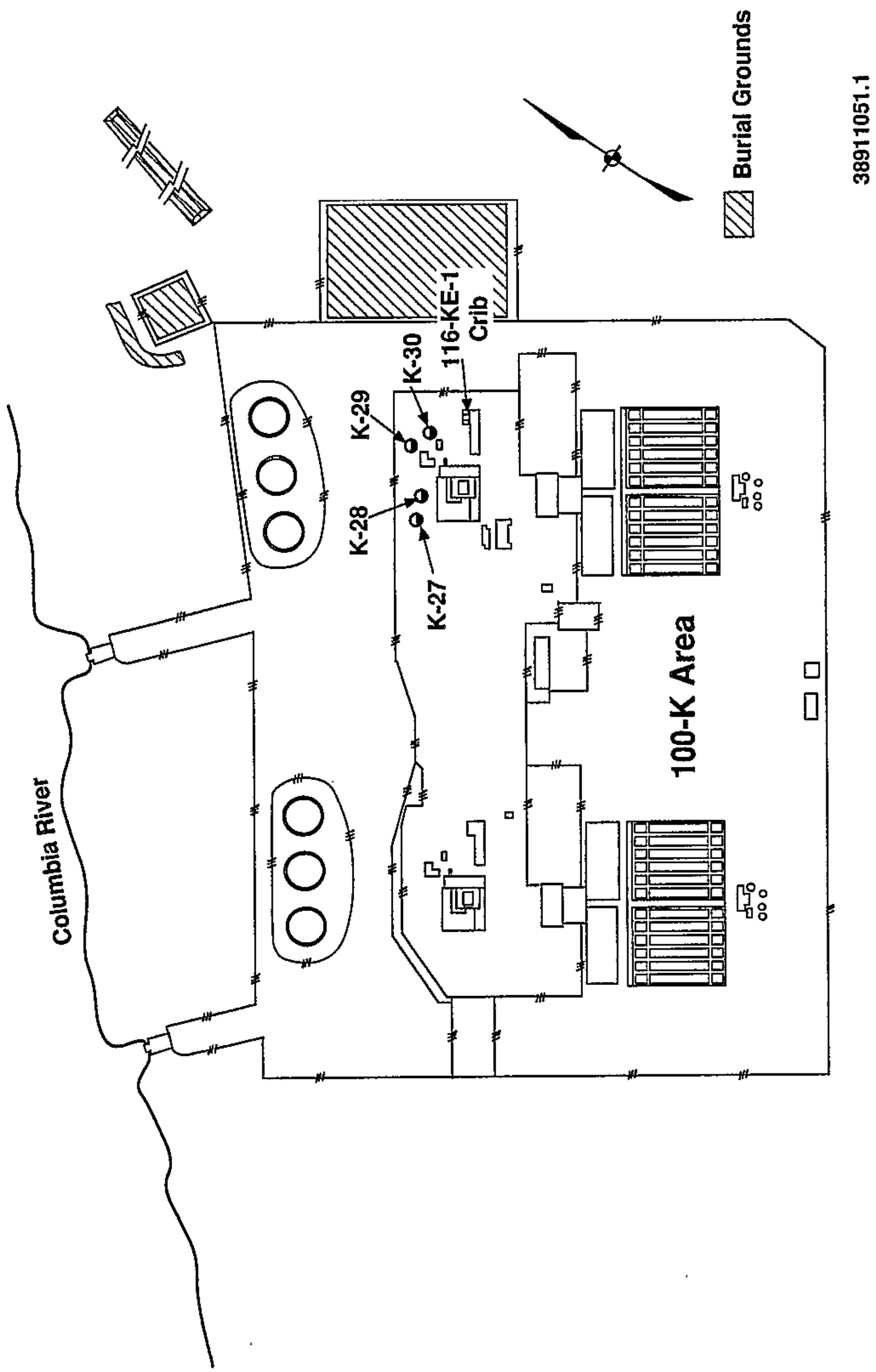
Figure A-2. Site Map of Inactive 116-KE-1 Crib Showing Well Locations.



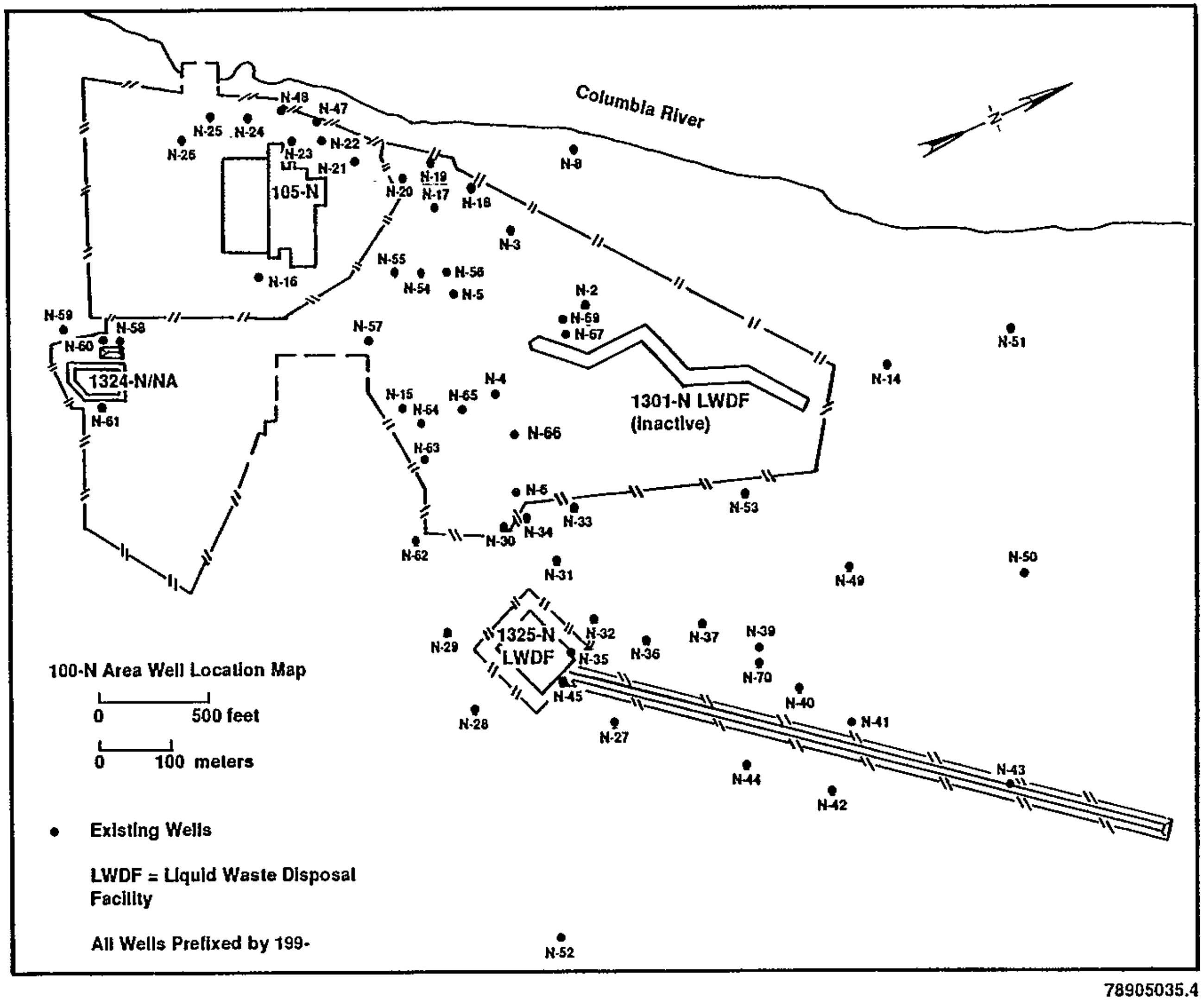


Figure A-3. 100-N Area Selected Sampling Well Location Map.

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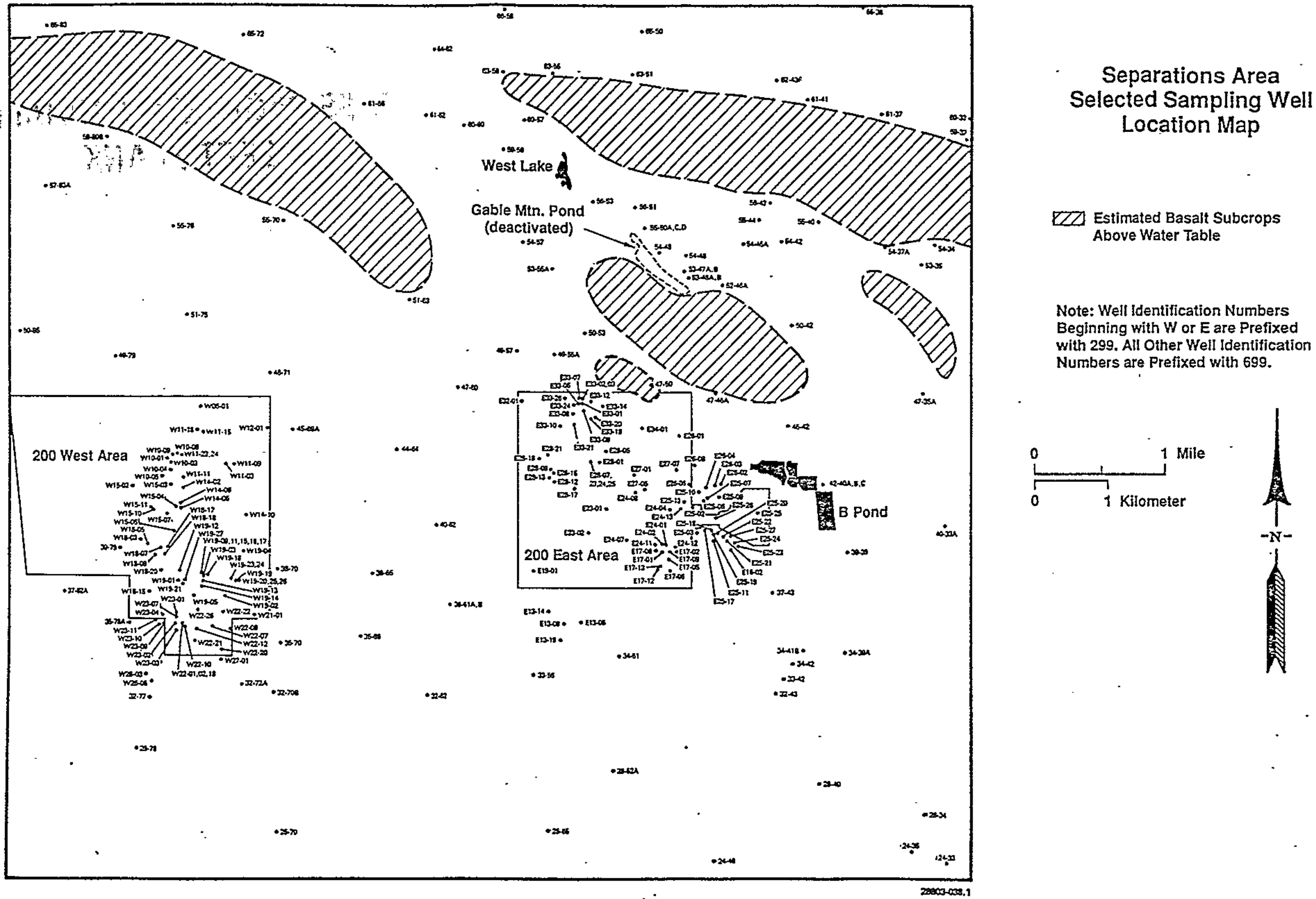

Figure A-4. 200 Areas Selected Sampling Well Location Map.

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Figure A-5. Site Map of Active 216-A-8 Crib
Showing Well Locations.

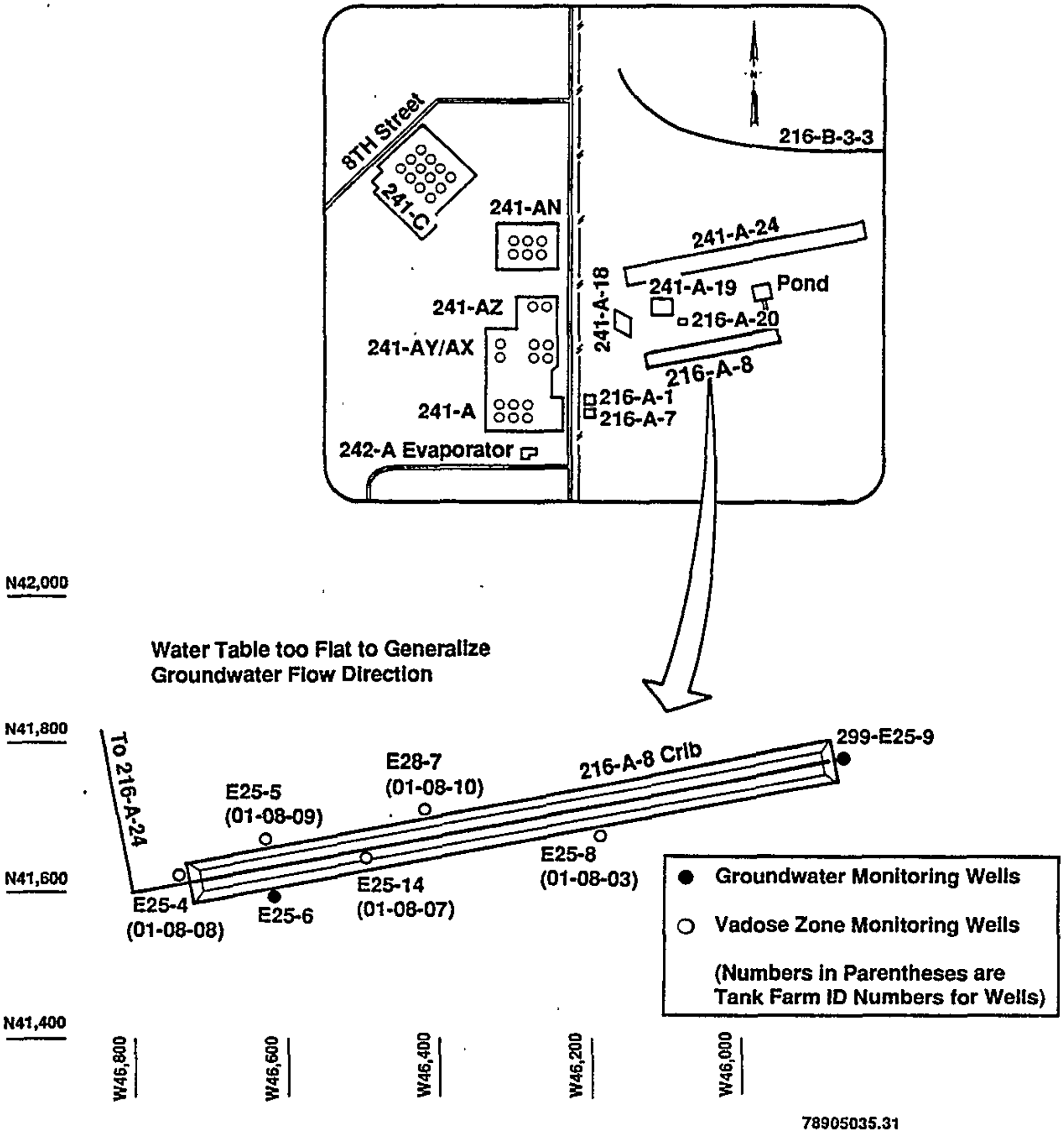


Figure A-6. Site Map of Inactive 216-A-10 Crib Showing Well Locations.

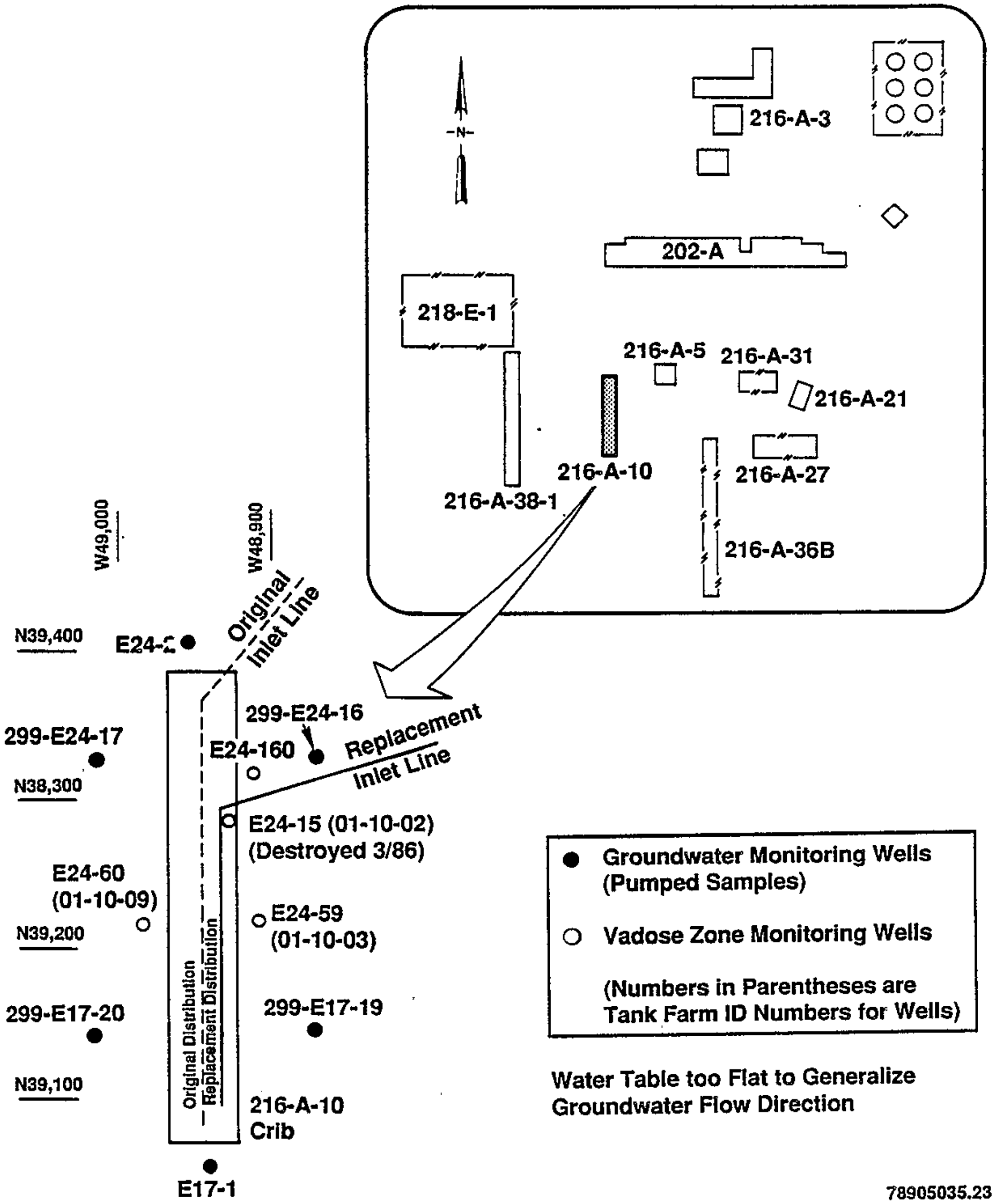


Figure A-7. Site Map of the Deactivated 216-A-25 Pond Showing Well Locations.

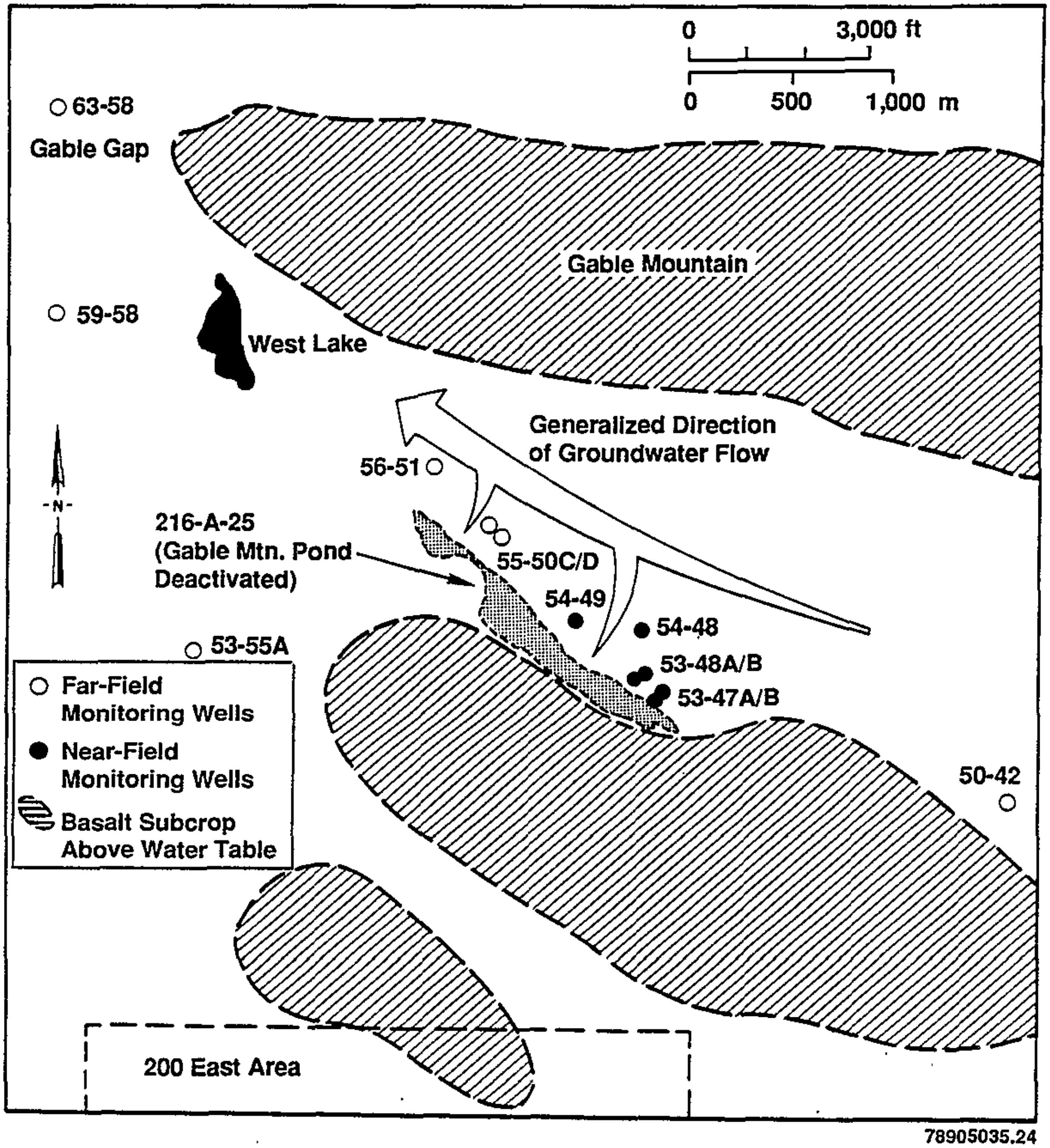


Figure A-8. Site Map of Active 216-A-30 Crib Showing Well Locations.

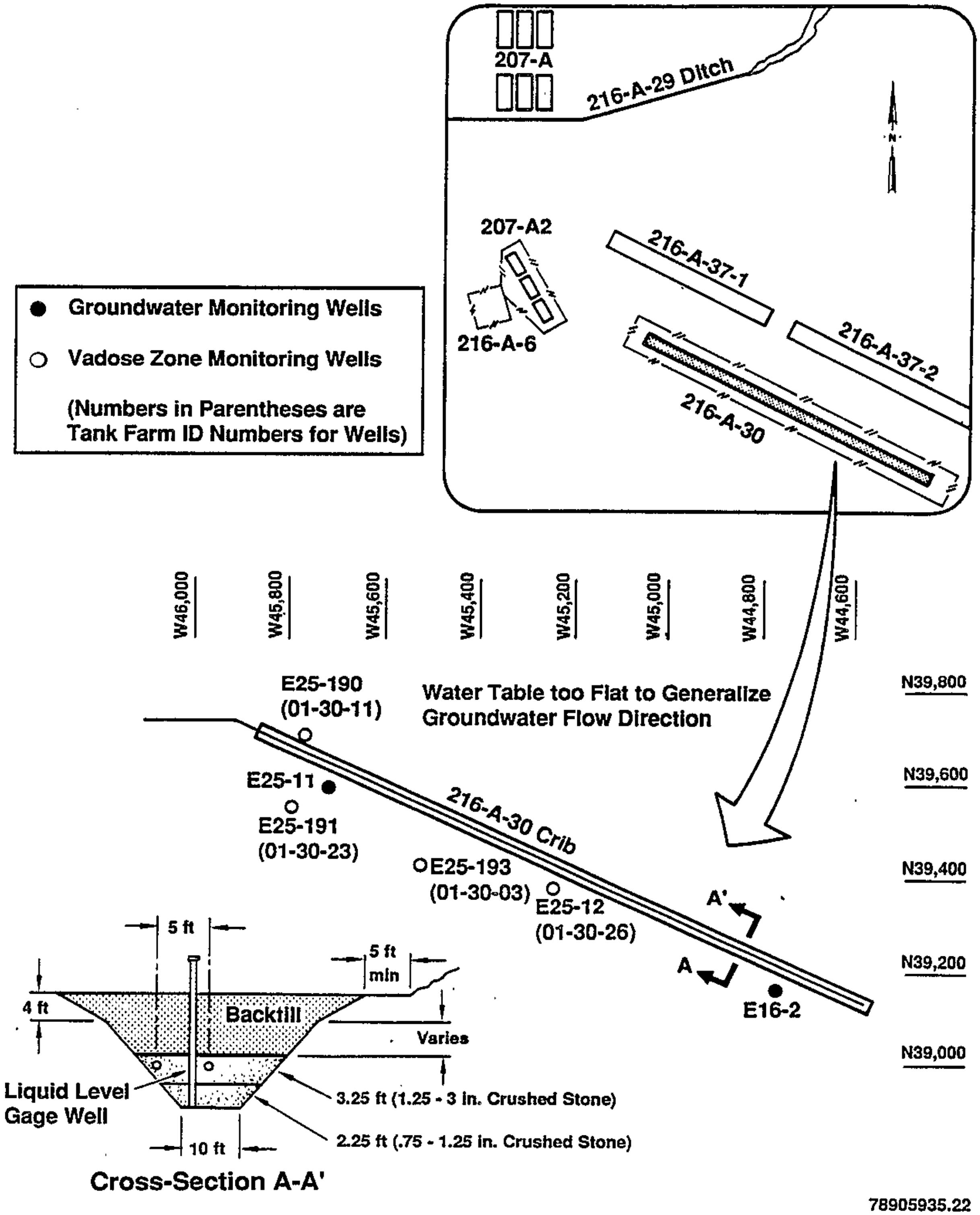


Figure A-9. Site Map of Inactive 216-A-36B Crib Showing Well Locations.

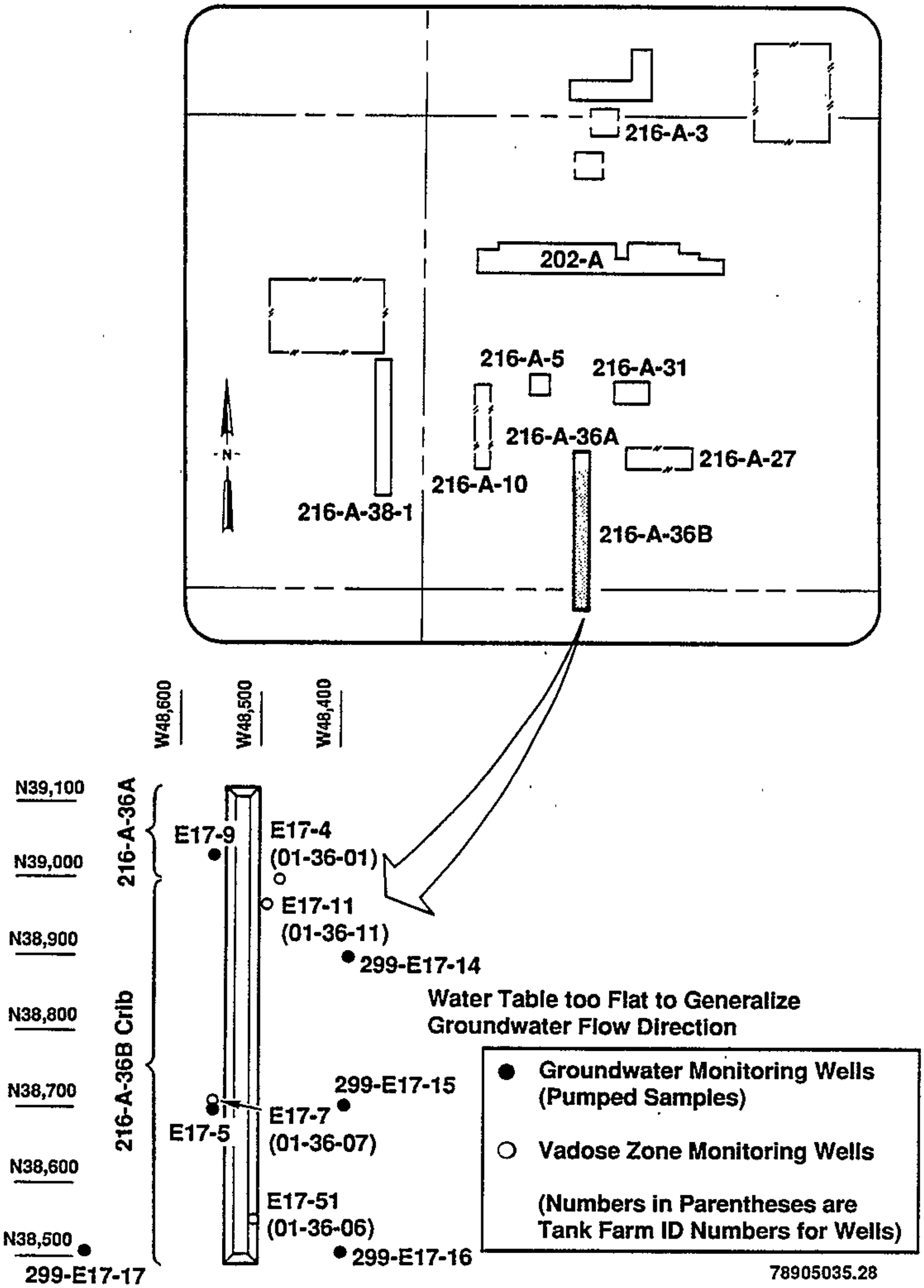


Figure A-10. Site Map of Active 216-A-37-1 Crib Showing Well Locations.

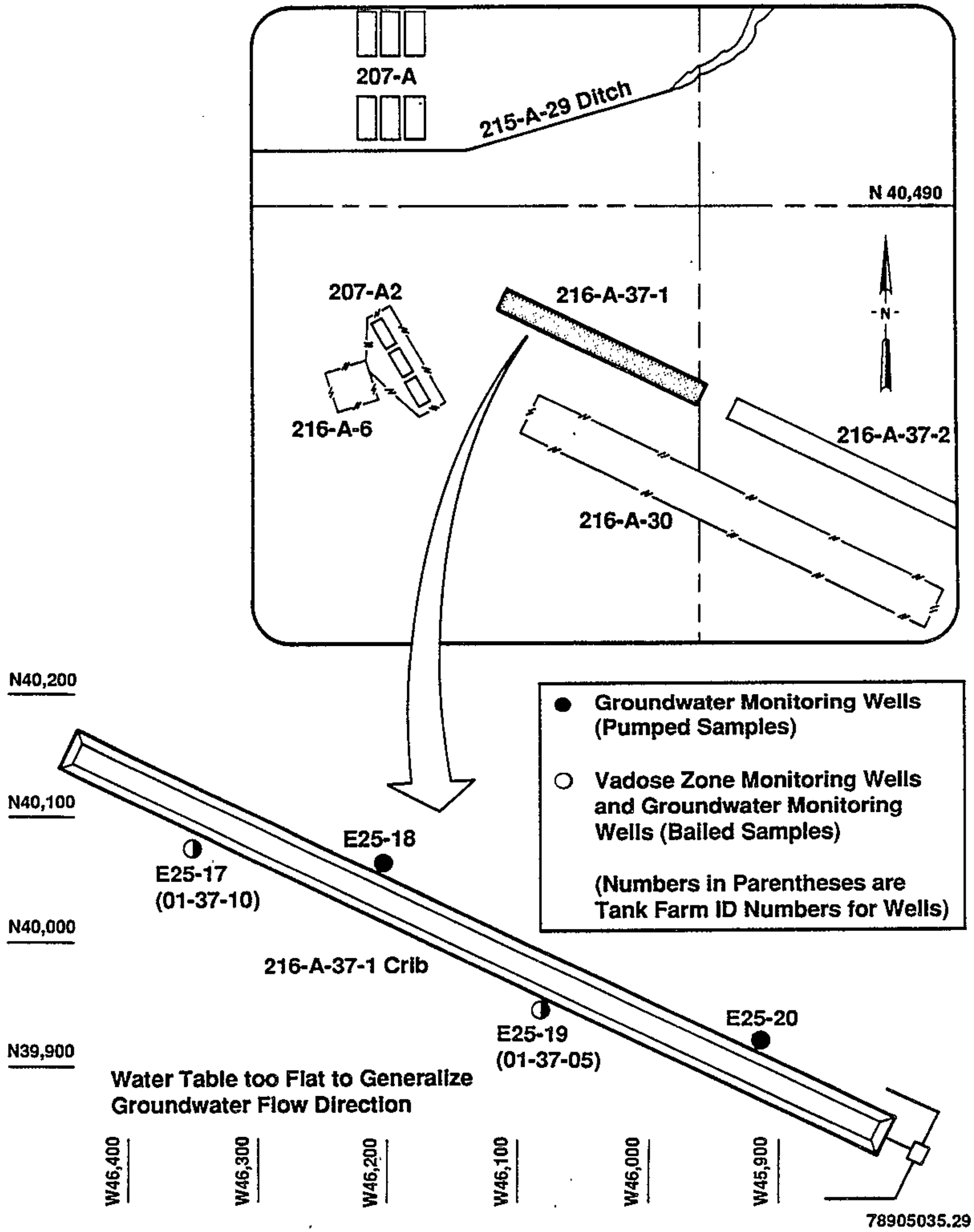


Figure A-11. Site Map of Active 216-A-37-2 Crib Showing Well Locations.

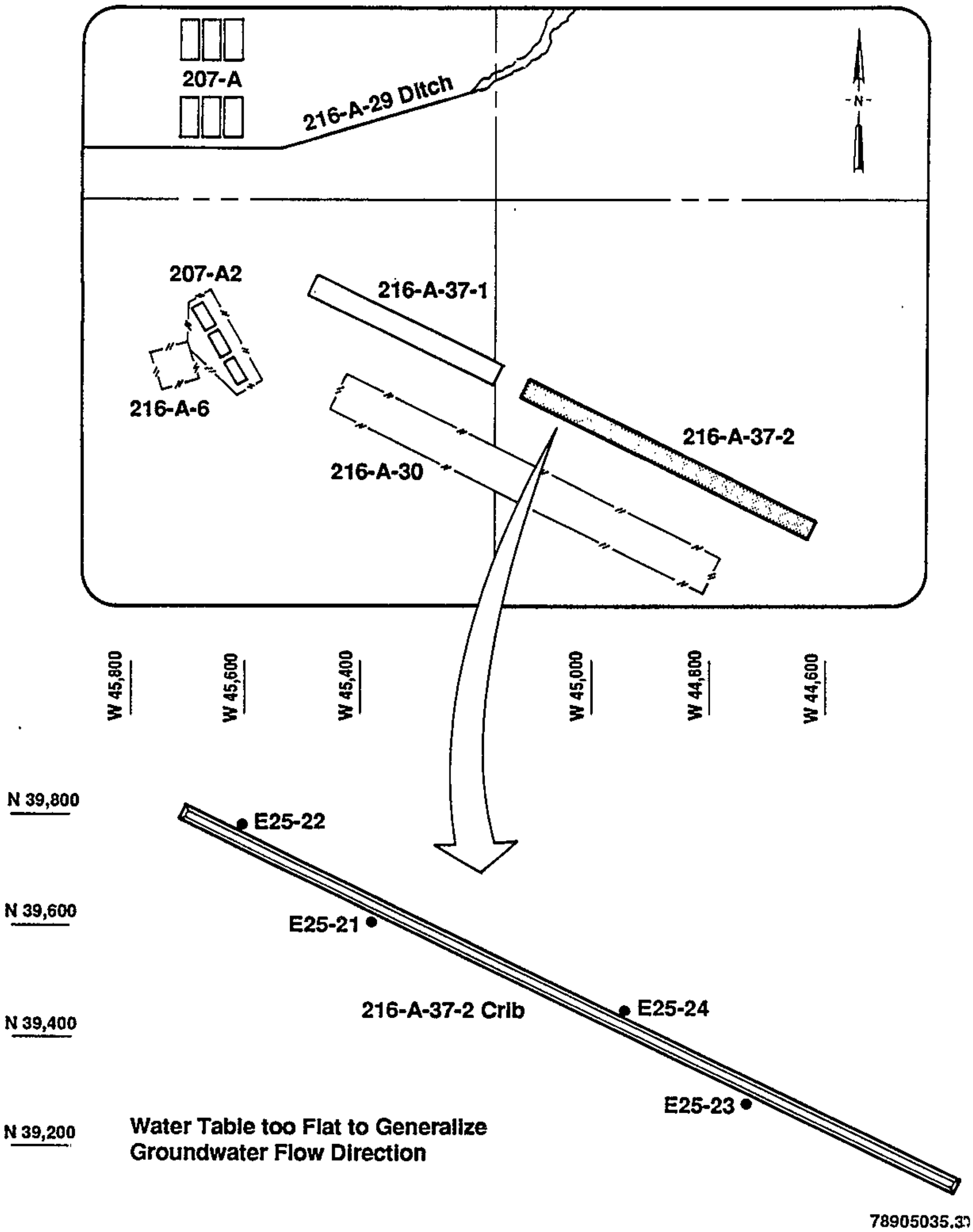
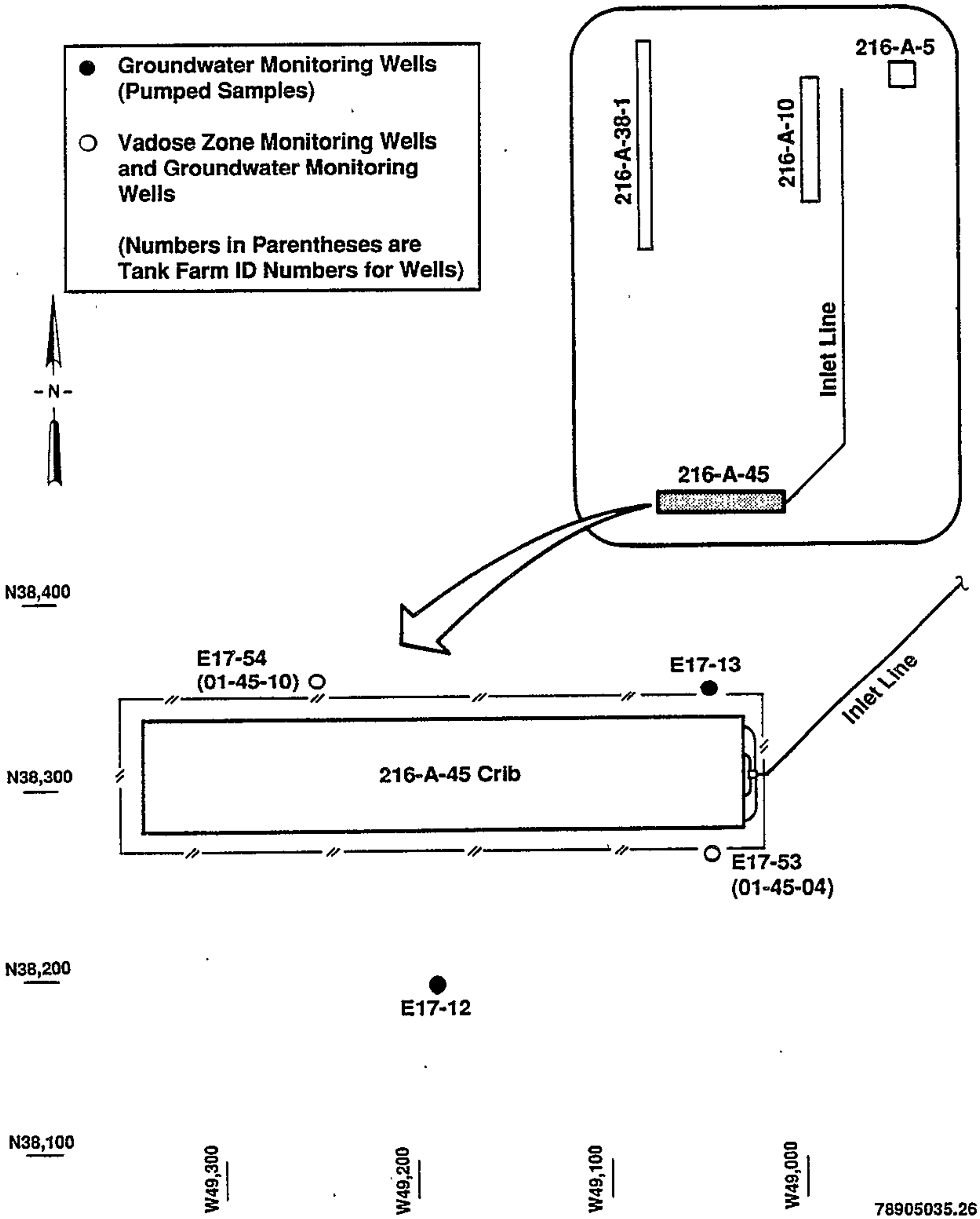


Figure A-12. Site Map of Active 216-A-45 Crib Showing Well Locations.



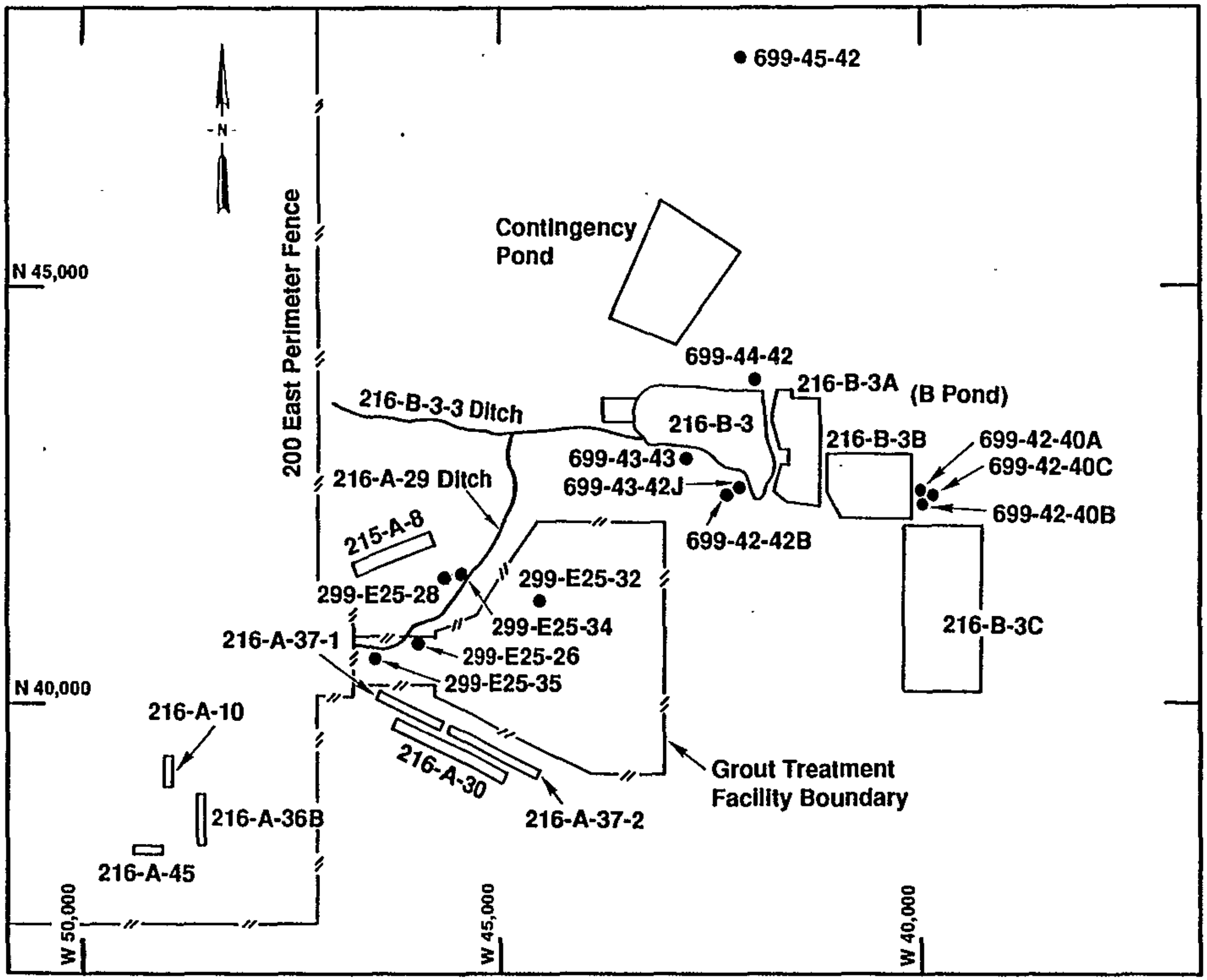


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Figure A-13. Site Map of Active 216-A-29 Ditch and 216-B-3 Pond Showing Well Locations.

Figure A-14. Site Map of Inactive 216-B-5 Reverse Well Showing Well Locations.

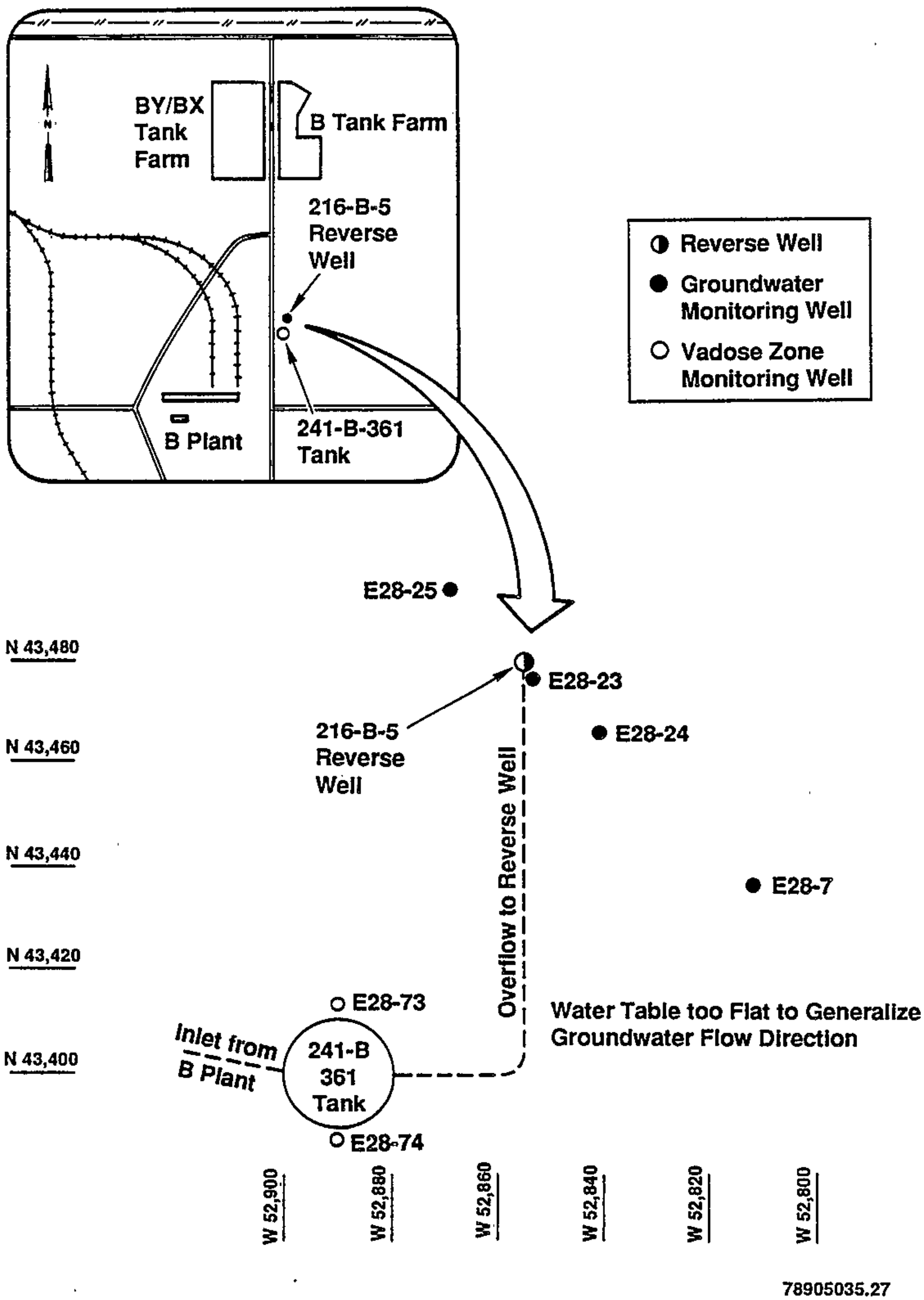


Figure A-15. Site Map of Active 216-B-55 Crib Showing Well Locations.

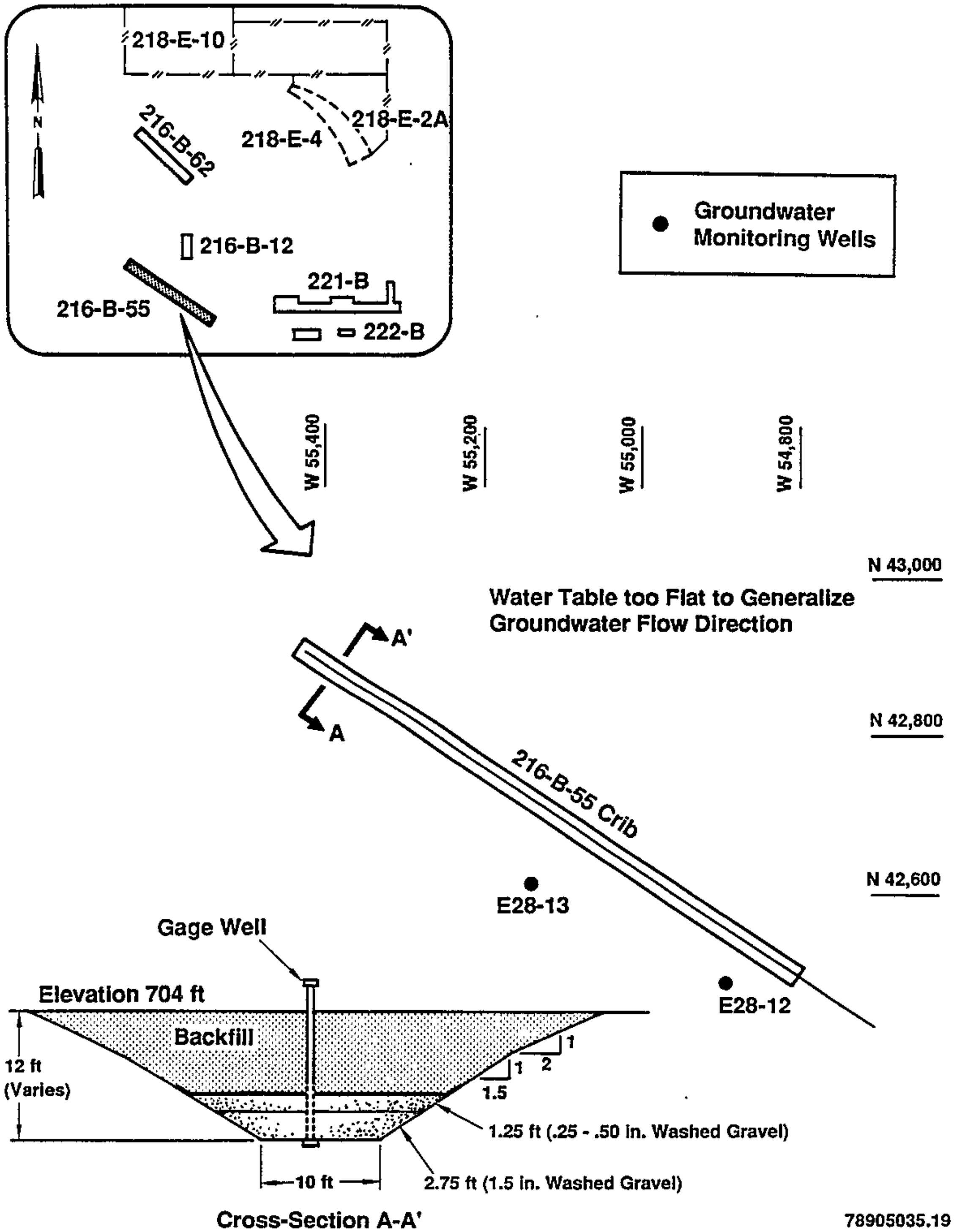


Figure A-16. Site Map of Active 216-B-62 Crib Showing Well Locations.

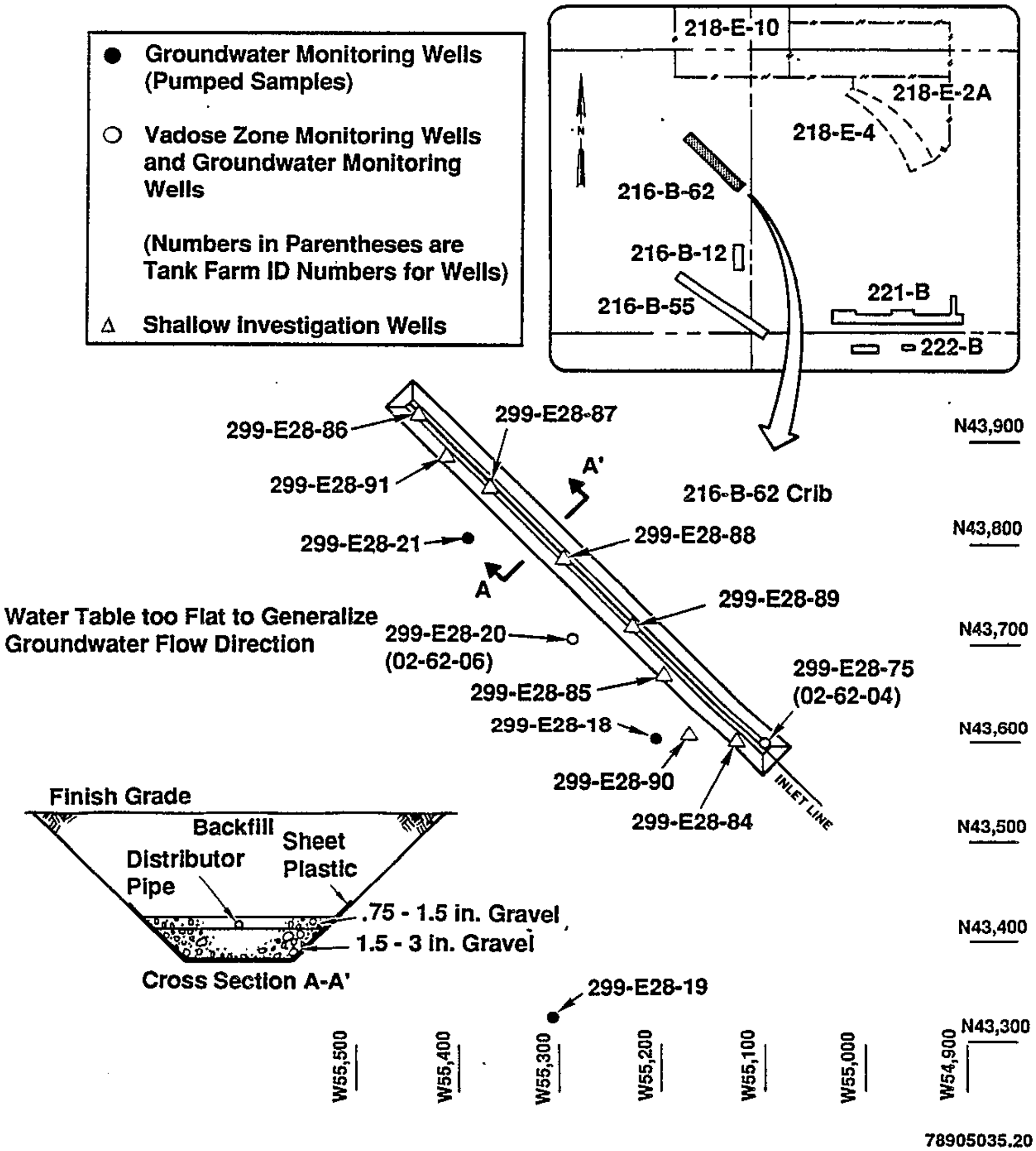


Figure A-17. Site Map of Active 216-B-63 Ditch Showing Well Locations.

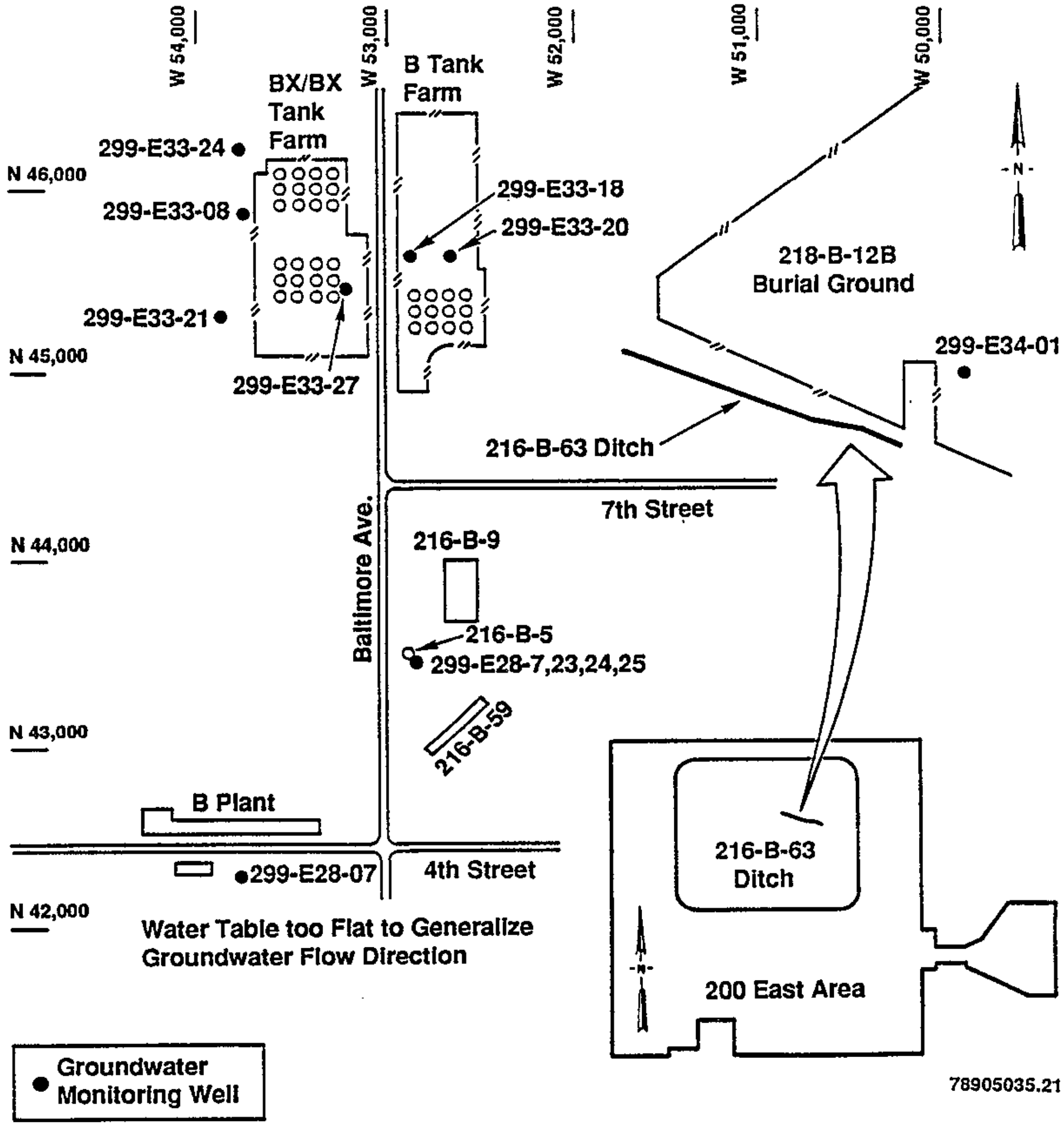


Figure A-18. Site Map of Active 216-S-25 Crib Showing Well Locations.

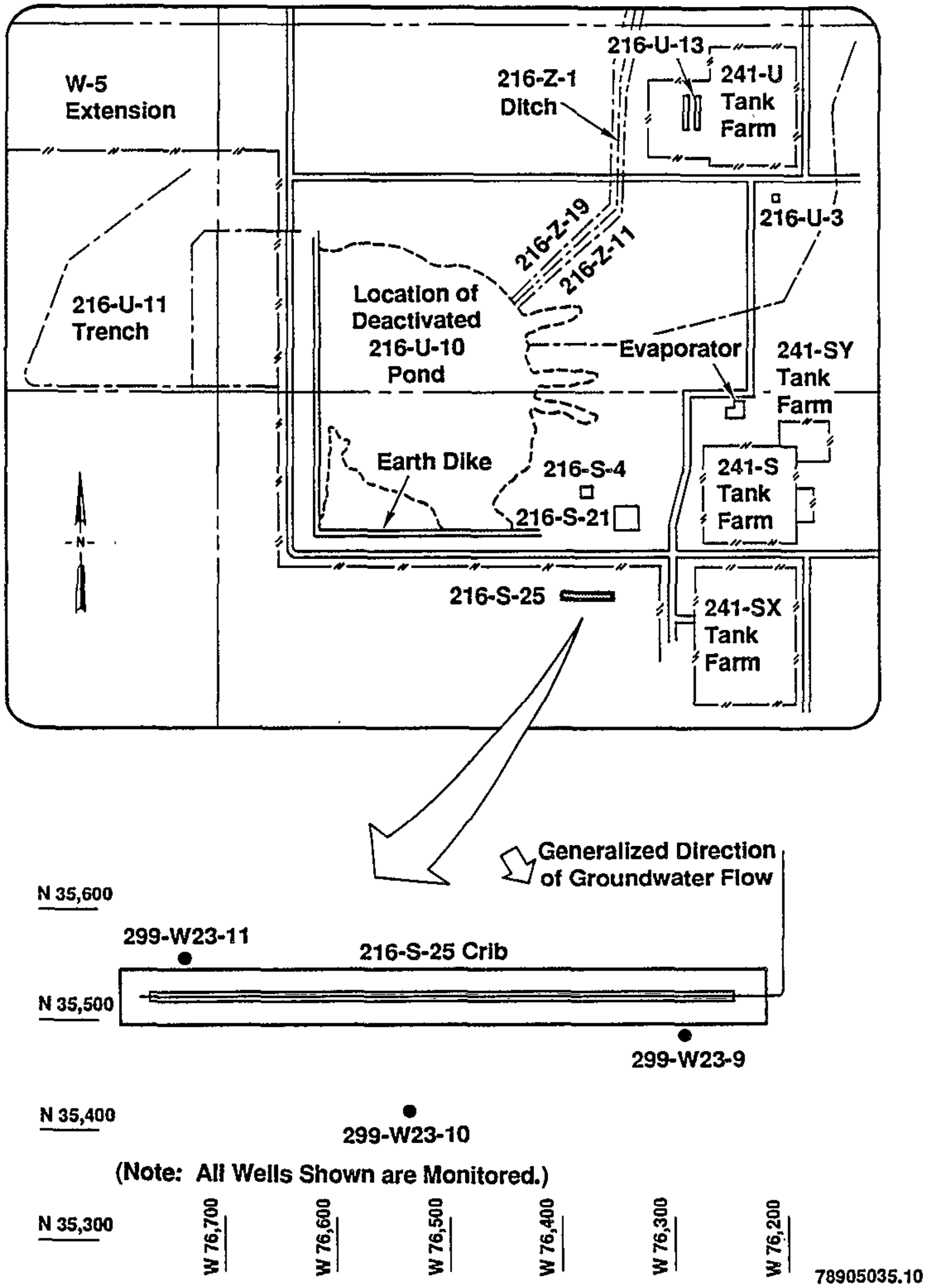


Figure A-19. Site Map of Active 216-S-26 Crib Showing Well Locations.

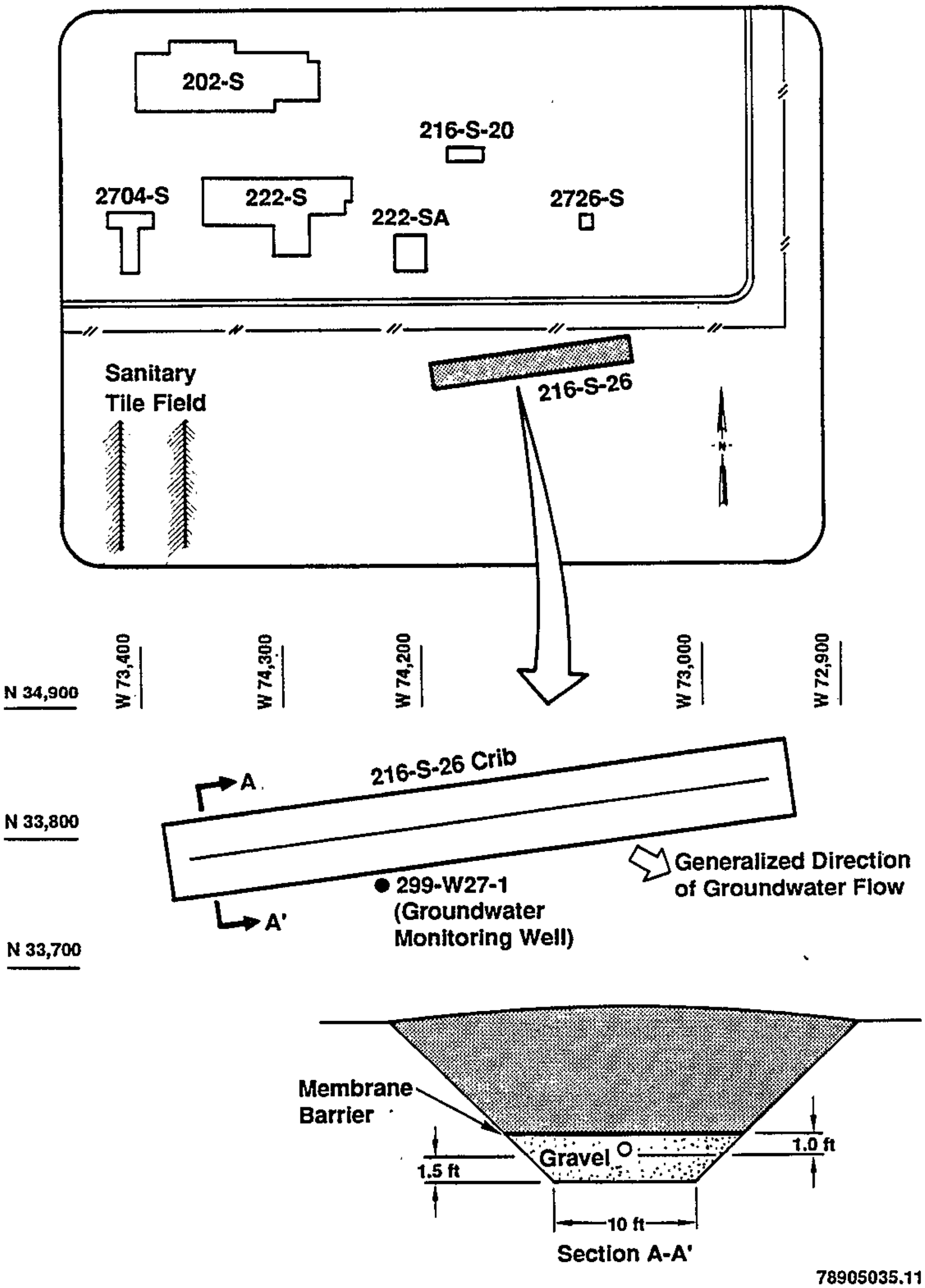


Figure A-20. Site Map of Inactive 216-U 1/2 Cribs Showing Well Locations.

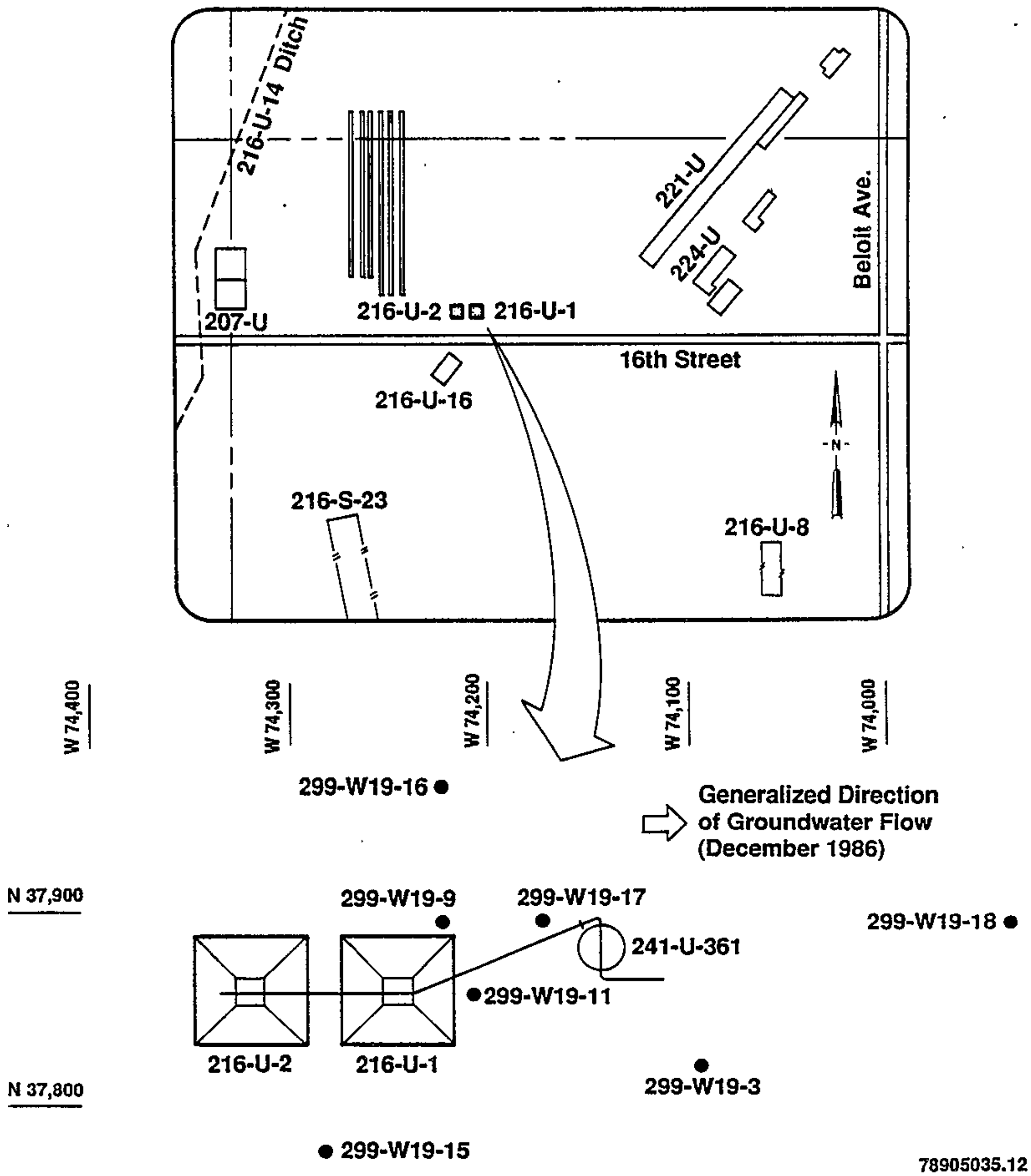


Figure A-21. Site Map of Inactive 216-U-10 Pond Showing Well Locations.

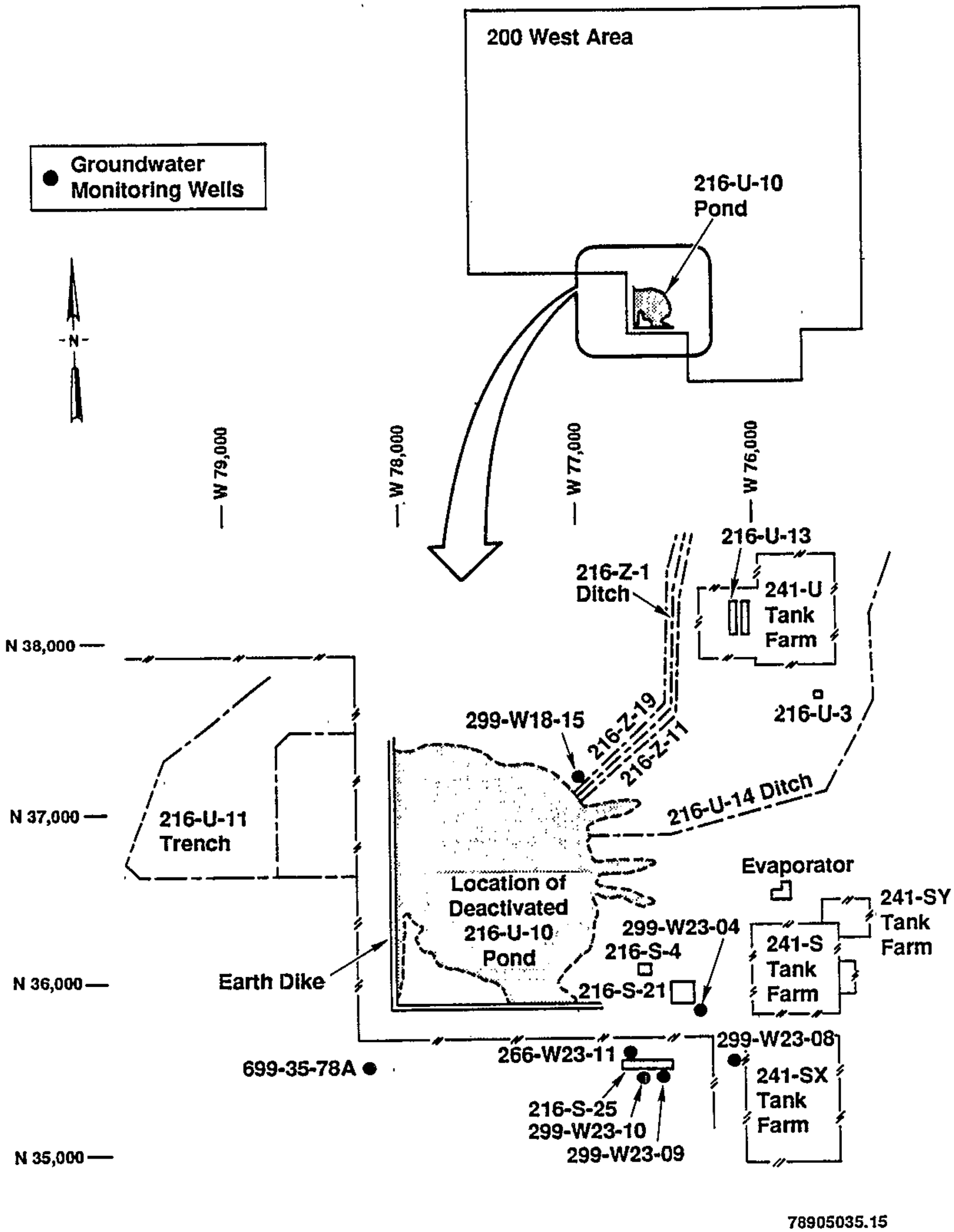


Figure A-22. Site Map of Active 216-U-14 Ditch Showing Well Locations.

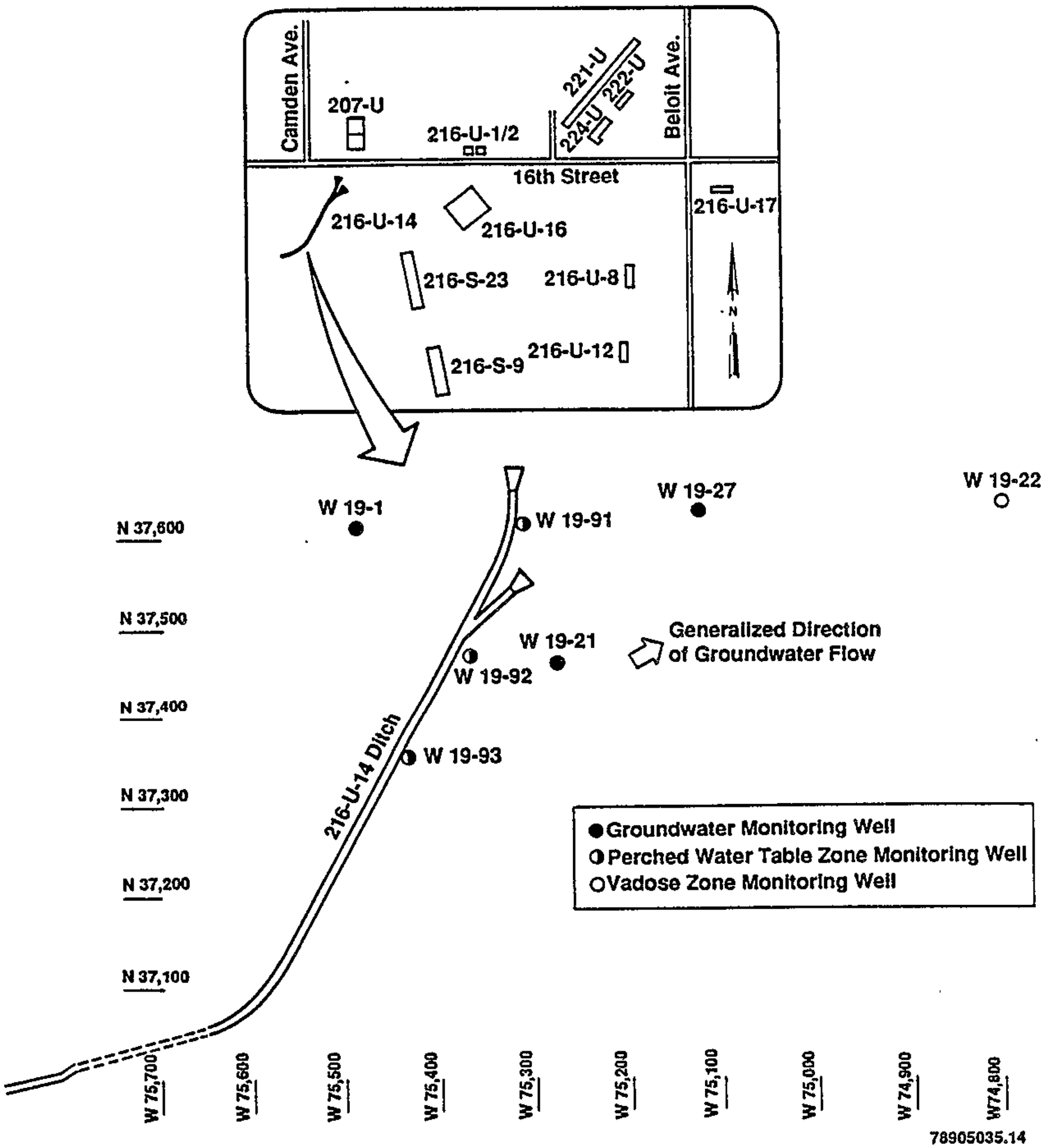


Figure A-23. Site Map of Active 216-U-17 Crib
Showing Well Locations.

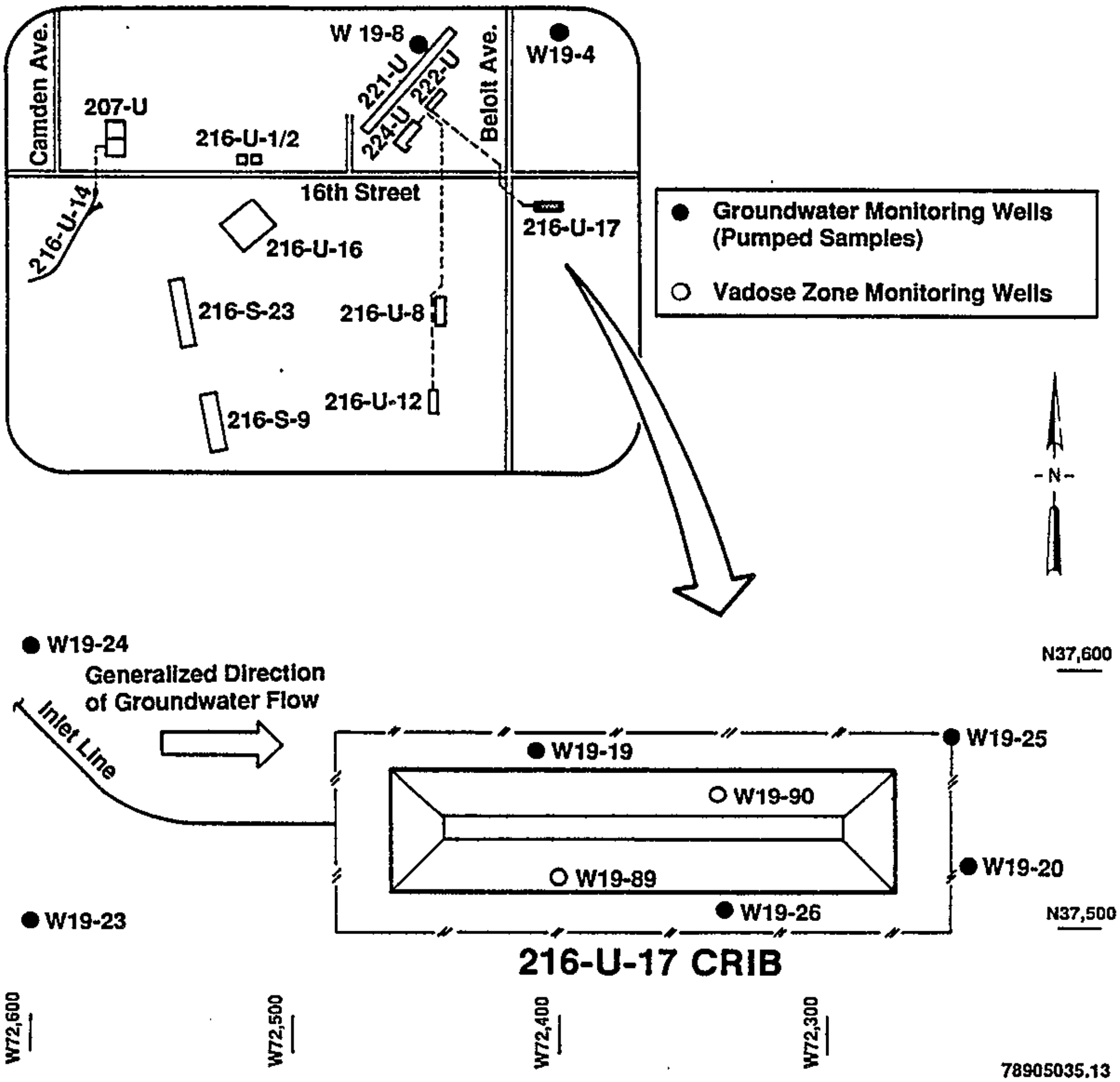


Figure A-24. Site Map of Active 216-W-LWC Crib Showing Well Locations.

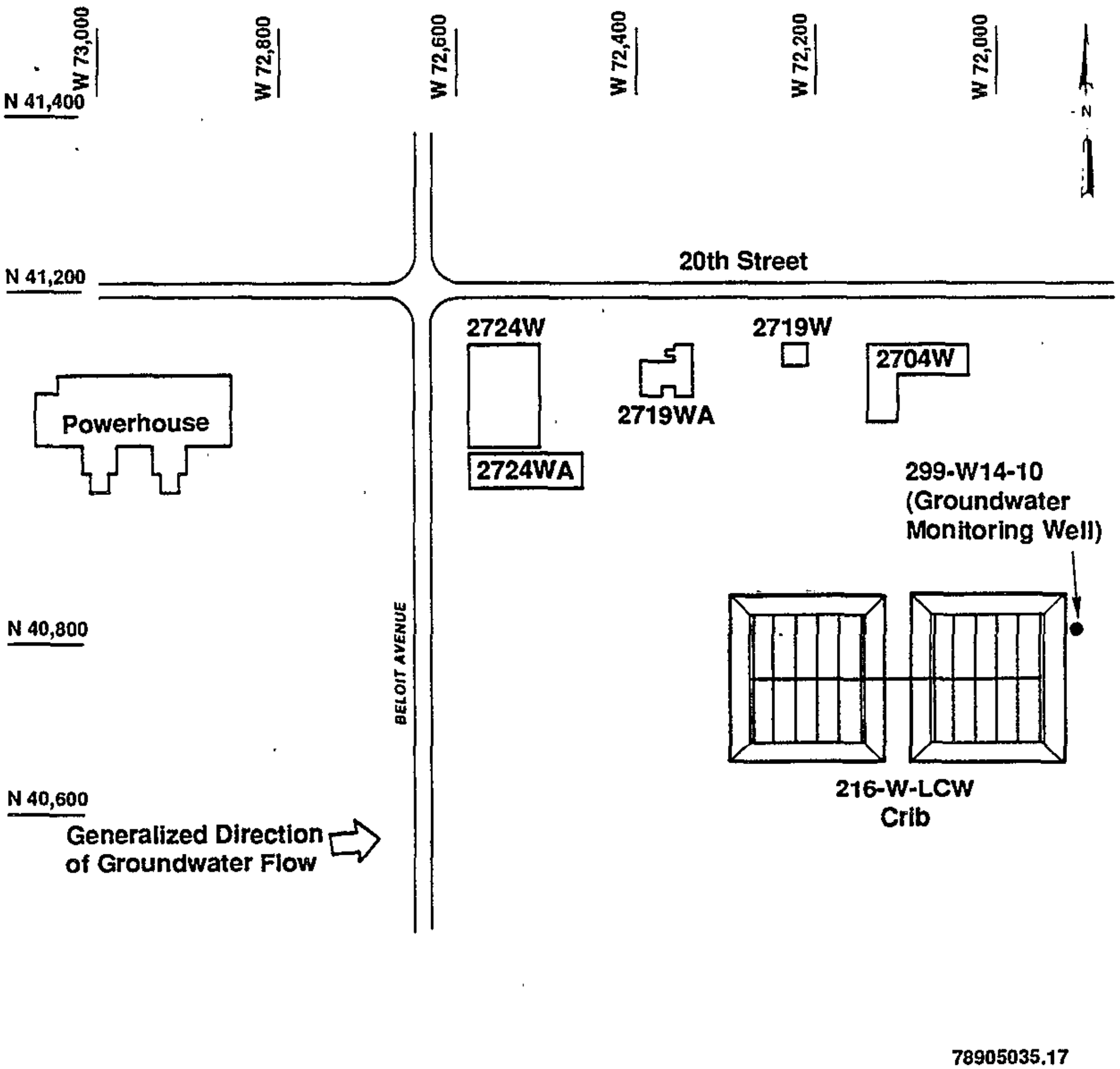


Figure A-25. Site Map of Active 216-Z-20 Crib
Showing Well Locations.

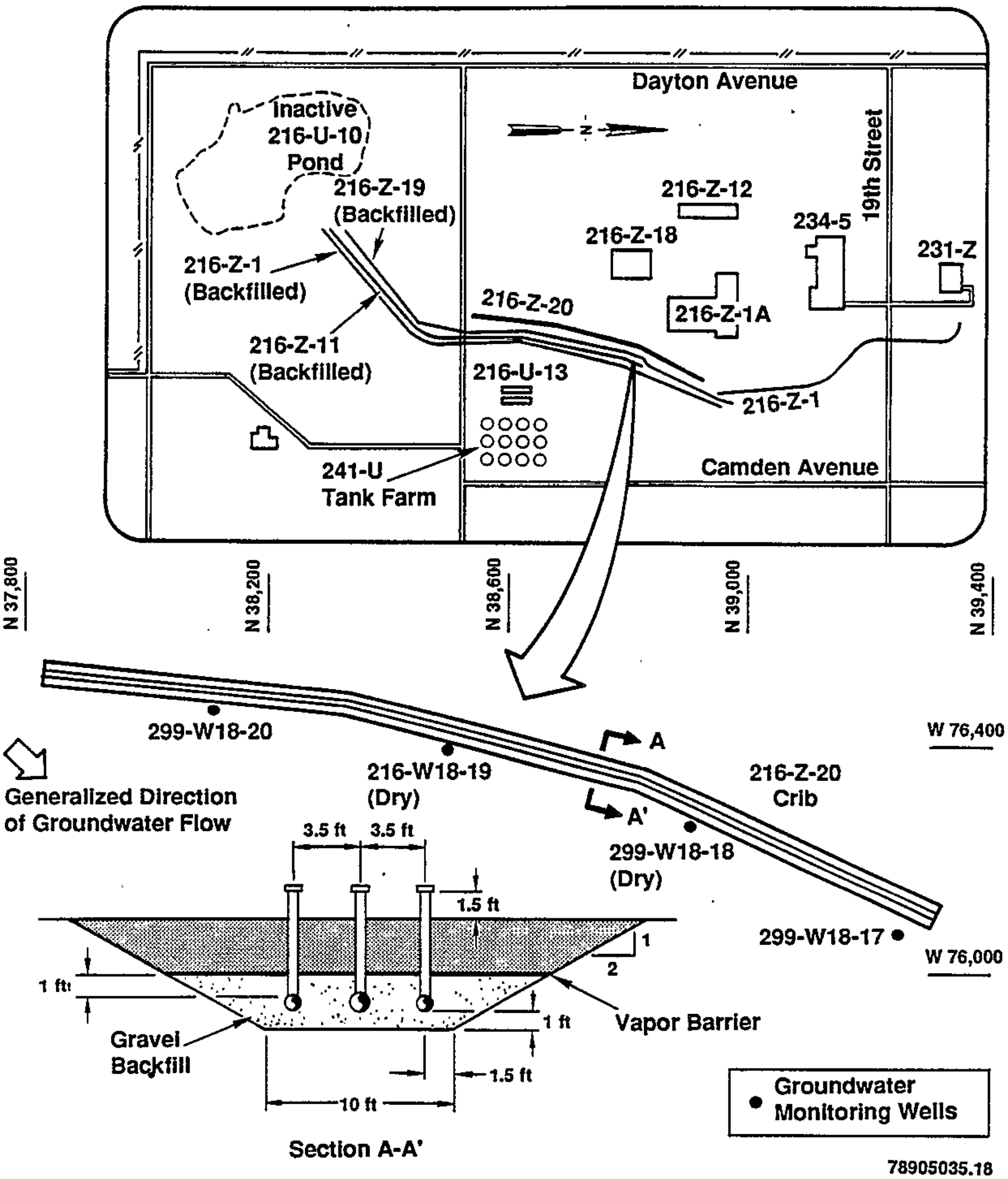


Figure A-26. 300 Area Selected Sampling Well Location Map.

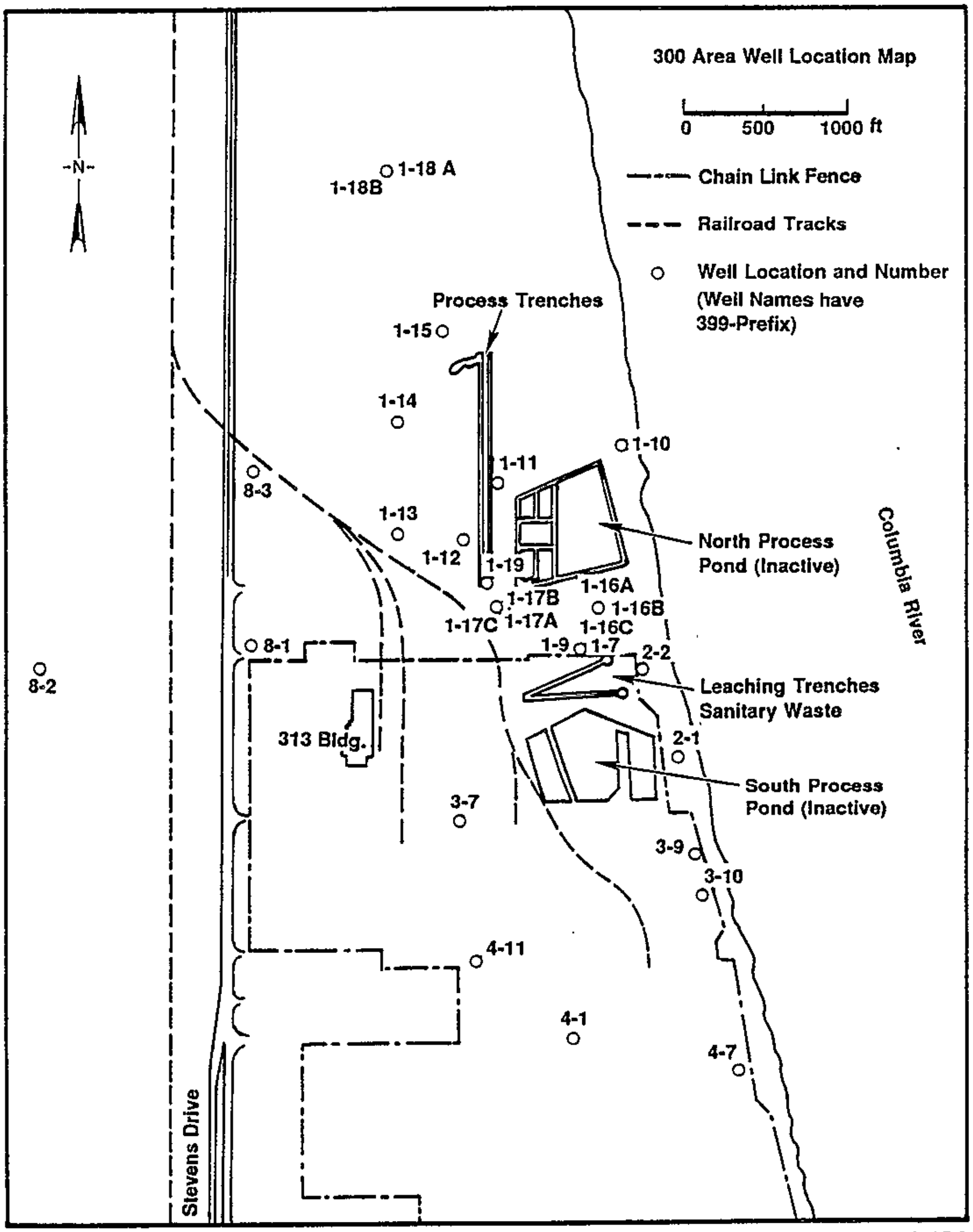
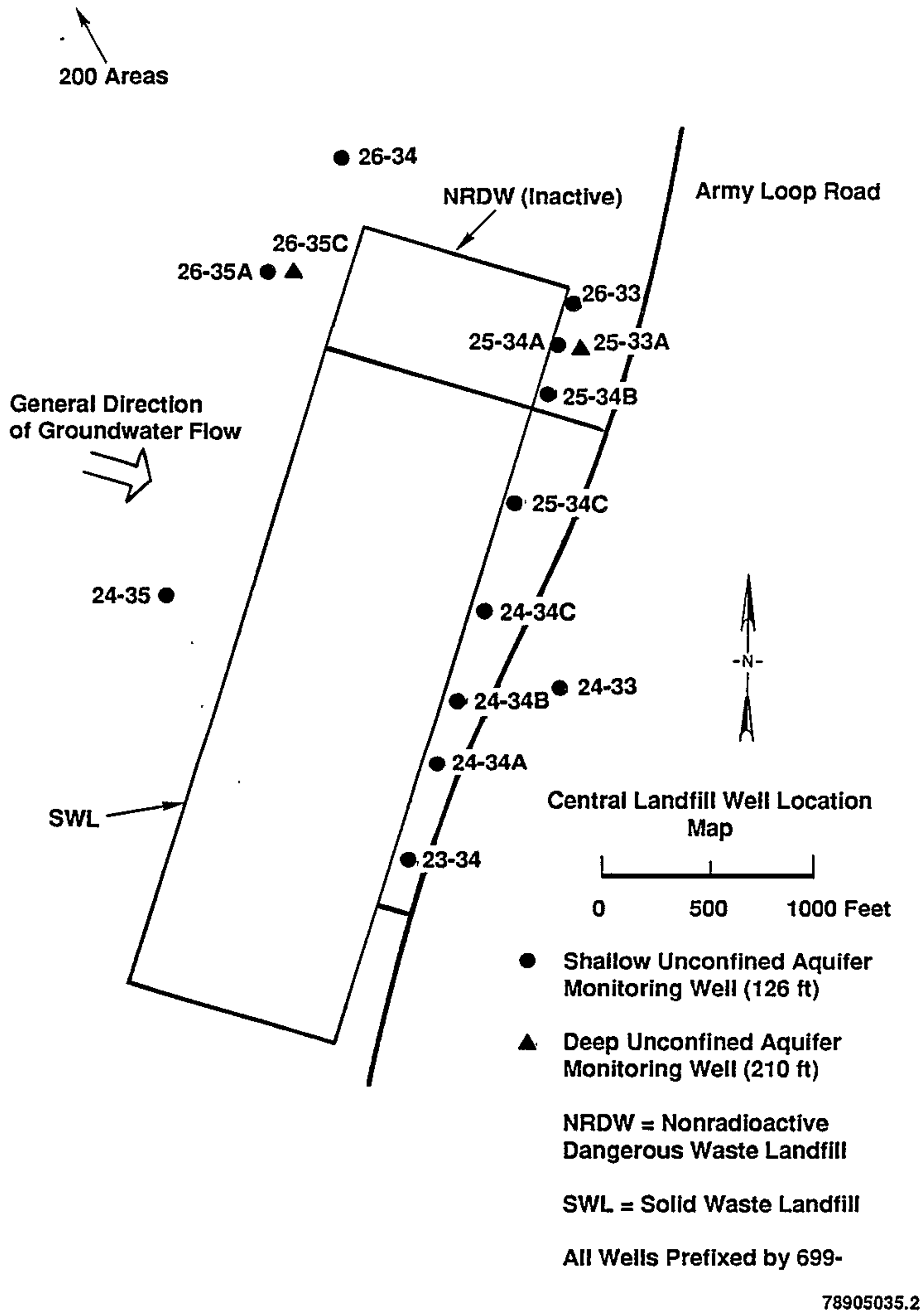


Figure A-27. Central Landfill Well Location Map.



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APPENDIX B

RESULTS OF THE OPERATIONAL GROUNDWATER MONITORING NETWORK

LIST OF TABLES

B.1 RESULTS OF THE OPERATIONAL GROUNDWATER MONITORING NETWORK

B.1.1 EXPLANATION OF DATA TABLES

The following explanations are relevant to the data summaries presented in this appendix.

- Negative readings for some radionuclide analyses occur when background radiation levels, which are subtracted from the result, are higher than the measured sample result.
- Detection limits of the constituent analyses are presented in Table 5 in the main text.
- The value of "NN" indicates that analysis for the constituent was not necessary, based on waste inventory, effluent history, or gross alpha and beta results.
- The number in parentheses following the average of the result is the number of samples analyzed for the constituent during 1988.
- An asterisk following a result indicates that a "flier" result was not included in the computation of the data summary. A flier is only removed if there is a reasonable suspicion that an error in sampling or analysis produced the anomalous result.

B.1.2 DATA TABLES

Tables B-1, B-2, B-3, and B-4 summarize the results of groundwater analyses performed on samples collected for the Operational Groundwater Monitoring Network during 1988.

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 1 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	1.58	8.62	390.00	16100.00
2-E13-14	Average (#)	1.00 (2)	7.01 (4)	233.75 (2)	14460.00 (5)
(216-B-29)	Minimum	0.42	5.96	77.50	12900.00
	Maximum		7.55	218.00	11500.00
2-E13-19	Average (#)	NN	6.60 (4)	157.95 (2)	10950.00 (2)
(216-B-28)	Minimum		4.90	97.90	10400.00
	Maximum	2.86	9.88	12.90	12200.00
2-E13-5	Average (#)	2.17 (2)	6.90 (4)	-152.28 (4)	11775.00 (4)
(216-B-18)	Minimum	1.47	5.16	-324.00	11200.00
	Maximum		7.99	-29.10	21300.00
2-E13-8	Average (#)	NN	6.37 (4)	-35.30 (2)	18500.00 (2)
(216-B-21)	Minimum		3.82	-41.50	15700.00
	Maximum	1.59	23.60	17300.00	5240.00
2-E16-2	Average (#)	0.93 (12)	9.46 (12)	3253.92 (12)	2562.14 (14)
(216-A-30)	Minimum	0.63	6.05	737.00	1500.00
	Maximum	4.15	34.20	8050000.00	300000.00
2-E17-1	Average (#)	2.62 (2)	32.75 (2)	8050000.00 (1)	251000.00 (2)
(216-A-10)	Minimum	1.08	31.30	8050000.00	202000.00
	Maximum	4.41	113.00	1930000.00	56600.00
2-E17-12	Average (#)	3.68 (12)	67.81 (12)	1503500.00 (11)	49984.62 (13)
(216-A-45)	Minimum	2.88	29.90	952000.00	37900.00
	Maximum	4.96	184.00	2430000.00	85200.00
2-E17-13	Average (#)	3.75 (12)	99.08 (12)	1048583.33 (12)	62783.33 (12)
(216-A-45)	Minimum	2.80	34.60	291000.00	40500.00
	Maximum	8.21	240.00	112000.00	121000.00
2-E17-2	Average (#)	4.86 (12)	106.98 (12)	44125.00 (12)	89441.67 (12)
(216-A-27)	Minimum	2.49	28.20	22300.00	51300.00
	Maximum	8.01	814.00	4210000.00	234000.00
2-E17-5	Average (#)	6.18 (15)	529.08 (15)	1509000.00 (13)	173800.00 (15)
(216-A-36B)	Minimum	2.04	66.80	187000.00	114000.00
	Maximum	1.45	148.00	8240.00	46500.00
2-E17-6	Average (#)	0.91 (5)	31.36 (7)	3443.18 (5)	9430.00 (7)
(216-A-36B)	Minimum	-0.14	5.61	68.90	500.00
	Maximum		42.90	5830000.00	222000.00
2-E17-8	Average (#)	NN	33.83 (4)	4532500.00 (4)	167250.00 (4)
(216-A-10)	Minimum		22.60	2780000.00	80000.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 2 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	3.14	37.30	4750000.00	146000.00
2-E17-9	Average (#)	2.46 (6)	27.87 (6)	4220000.00 (6)	127000.00 (7)
(216-A-36B)	Minimum	1.63	21.00	3760000.00	113000.00
	Maximum	5.49	66.80	7810000.00	334000.00
2-E24-1	Average (#)	4.15 (4)	48.92 (11)	4347272.73 (11)	181066.67 (12)
(216-A-5)	Minimum	3.50	17.00	1920000.00	82800.00
	Maximum		58.70	8070000.00	234000.00
2-E24-11	Average (#)	NN	22.33 (12)	4985000.00 (4)	159250.00 (4)
(216-A-10)	Minimum		12.20	2250000.00	114000.00
	Maximum		809.00	2360000.00	164000.00
2-E24-12	Average (#)	NN	332.93 (8)	365500.00 (8)	124050.00 (8)
(216-A-21,31)	Minimum		36.40	53600.00	97400.00
	Maximum		6.72	6390.00	2500.00
2-E24-13	Average (#)	NN	6.20 (4)	6255.00 (2)	2500.00 (4)
(241-A)	Minimum		5.64	6120.00	2500.00
	Maximum	4.87	45.60	4630000.00	172000.00
2-E24-2	Average (#)	3.05 (5)	33.46 (5)	3007500.00 (4)	107400.00 (6)
(216-A-10)	Minimum	0.93	20.50	1990000.00	66400.00
	Maximum		5.17	10800.00	2750.00
2-E24-4	Average (#)	NN	4.59 (4)	9787.50 (4)	2562.50 (4)
(216-A-9)	Minimum		3.69	8430.00	2500.00
	Maximum		33.10	11100.00	4090.00
2-E24-8	Average (#)	NN	20.33 (4)	8990.00 (3)*	3703.33 (4)*
(216-C-3,4,5)	Minimum		8.93	7570.00	3220.00
	Maximum	0.92	4.65		
2-E25-10	Average (#)	0.77 (2)	4.31 (2)	NN	NN
(216-A-19)	Minimum	0.63	3.97		
	Maximum	1.34	14.60	777000.00	57300.00
2-E25-11	Average (#)	1.03 (12)	12.11 (12)	568083.33 (12)	40566.67 (12)
(216-A-30)	Minimum	0.66	9.10	425000.00	32000.00
	Maximum		9.00		129000.00
2-E25-13	Average (#)	NN	7.82 (4)	NN	97375.00 (4)
(241-AX)	Minimum		6.71		68200.00
	Maximum	1.17	11.40	468000.00	27700.00
2-E25-17	Average (#)	0.75 (12)	9.10 (12)	294250.00 (11)	14390.00 (12)
(216-A-37-1)	Minimum	0.10	5.41	163000.00	7490.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 3 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)		Tritium (pCi/L)		Nitrate (p/b)	
	Maximum	1.48		13.30		552000.00		39500.00	
2-E25-18	Average (#)	1.10	(4)	8.53	(4)	263475.00	(4)	20505.00	(4)
(216-A-37-1)	Minimum	0.68		5.65		93900.00		7920.00	
	Maximum	1.50		73.70		4750000.00		168000.00	
2-E25-19	Average (#)	1.06	(4)	46.00	(4)	2954000.00	(4)	110360.00	(5)
(216-A-37-1)	Minimum	0.76		12.80		596000.00		63800.00	
	Maximum			5.08		6210.00		2500.00	
2-E25-2	Average (#)	NN		4.70	(2)	6075.00	(2)	2500.00	(2)
(216-A-1,7)	Minimum			4.32		5940.00		2500.00	
	Maximum	1.85		18.50		1280000.00		182000.00	
2-E25-20	Average (#)	1.38	(4)	15.75	(4)	1026250.00	(4)	165200.00	(5)
(216-A-37-1)	Minimum	1.14		13.70		745000.00		144000.00	
	Maximum	2.04		13.10		8680.00		8400.00	
2-E25-21	Average (#)	1.24	(4)	10.72	(4)	4977.50	(4)	5740.00	(5)
(216-A-37-2)	Minimum	0.53		9.43		2590.00		2500.00	
	Maximum	1.23		6.69		8460.00		5880.00	
2-E25-22	Average (#)	0.91	(4)	5.77	(4)	6528.33	(6)	4123.33	(6)
(216-A-37-2)	Minimum	0.56		4.13		5070.00		2740.00	
	Maximum	0.90		16.10		603.00		2500.00	
2-E25-23	Average (#)	0.66	(4)	11.90	(4)	354.83	(4)	1876.00	(5)
(216-A-37-2)	Minimum	0.25		8.82		36.30		1100.00	
	Maximum	2.18		17.80		1040.00		3050.00	
2-E25-24	Average (#)	1.24	(4)	14.00	(4)	485.75	(4)	2118.00	(5)
(216-A-37-2)	Minimum	0.67		10.10		130.00		900.00	
	Maximum			5.71		5510.00		2500.00	
2-E25-3	Average (#)	NN		5.23	(4)	4925.00	(2)	2500.00	(2)
(216-A-6)	Minimum			4.50		4340.00		2500.00	
	Maximum	1.13		36.90		17900.00		2500.00	
2-E25-6	Average (#)	0.77	(11)	7.24	(11)	7125.45	(10)	2500.00	(4)
(216-A-8)	Minimum	0.36		2.74		4590.00		2500.00	
	Maximum	0.85		5.71		3580.00		2500.00	
2-E25-9	Average (#)	0.58	(10)	4.54	(10)	3227.50	(4)	2500.00	(4)
(216-A-8)	Minimum	0.15		3.20		3030.00		2500.00	
	Maximum			6.99		2980.00		2500.00	
2-E26-2	Average (#)	NN		5.26	(4)	2645.00	(4)	2500.00	(4)
(216-A-24)	Minimum			4.34		2340.00		2500.00	

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 4 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum		10.60	42800.00	2500.00
2-E26-4	Average (#)	NN	6.00 (4)	28375.00 (4)	2500.00 (4)
(216-A-24)	Minimum		3.23	17800.00	2500.00
	Maximum	3.69	8.90	4130.00	12600.00
2-E26-6	Average (#)	1.49 (4)	5.05 (4)	3392.50 (4)	5025.00 (4)
(401-A COOL)	Minimum	0.65	3.34	2310.00	2500.00
	Maximum		19.10	5990.00	11700.00
2-E27-5	Average (#)	NN	14.43 (2)	5170.00 (2)	7373.33 (3)
(216-C-10)	Minimum		9.76	4350.00	5050.00
	Maximum	1.05	6.17		2500.00
2-E27-7	Average (#)	0.90 (2)	5.48 (2)	NN	2500.00 (2)
(241-C)	Minimum	0.74	4.78		2500.00
	Maximum	13.80	22.60	277000.00	
2-E28-12	Average (#)	13.80 (1)	17.50 (12)	137241.67 (11)	NN
(216-B-55)	Minimum	13.80	13.70	97900.00	
	Maximum	3.22	8.36	7860.00	48700.00
2-E28-13	Average (#)	3.22 (1)	7.44 (4)	7097.50 (4)	44150.00 (2)
(216-B-55)	Minimum	3.22	6.56	5890.00	39600.00
	Maximum	8.31	8.29		
2-E28-16	Average (#)	7.74 (2)	8.25 (2)	NN	NN
(216-B-12)	Minimum	7.17	8.22		
	Maximum	10.40			
2-E28-17	Average (#)	7.48 (4)	NN	NN	NN
(216-B-6,10)	Minimum	4.85			
	Maximum	51.40	23.20	165000.00	42900.00
2-E28-18	Average (#)	31.95 (12)	16.50 (12)	40737.27 (11)	38223.08 (13)
(216-B-62)	Minimum	6.66	9.11	8410.00	26800.00
	Maximum	13.00	11.40		
2-E28-19	Average (#)	10.46 (4)	9.92 (4)	NN	NN
(216-B-62)	Minimum	7.90	8.59		
	Maximum	34.50	21.30	114000.00	41700.00
2-E28-21	Average (#)	27.97 (13)	15.43 (13)	30440.83 (12)	37300.00 (14)
(216-B-62)	Minimum	21.30	11.90	9590.00	34500.00
	Maximum	36.60	11600.00	8170.00	10700.00
2-E28-23	Average (#)	32.63 (4)	10725.00 (4)	7325.00 (4)	9792.00 (5)
(216-B-5)	Minimum	27.10	8300.00	6120.00	8700.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 5 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)		Tritium (pCi/L)		Nitrate (p/b)	
	Maximum	0.70		341.00					
2-E28-24	Average (#)	0.37	(4)	310.00	(4)	NN		NN	
(216-B-5)	Minimum	0.19		272.00					
	Maximum	15.50		10700.00					
2-E28-25	Average (#)	12.41	(4)	9210.00	(4)	NN		NN	
(216-B-5)	Minimum	8.73		7940.00					
	Maximum	2.56		218.00		7940.00		8290.00	
2-E28-7	Average (#)	1.43	(4)	145.25	(4)	7610.00	(2)	7826.67	(3)
(216-B-5)	Minimum	0.75		116.00		7280.00		7100.00	
	Maximum	6.10		8.70					
2-E28-9	Average (#)	5.44	(4)	7.78	(4)	NN		NN	
(216-B-12)	Minimum	4.02		7.10					
	Maximum			25.50		14400.00		10200.00	
2-E32-1	Average (#)	NN		24.45	(2)	11895.00	(2)	9290.00	(4)
(LLBG)	Minimum			23.40		9390.00		8360.00	
	Maximum			30.60		4430.00		44700.00	
2-E33-10	Average (#)	NN		28.10	(2)	4370.00	(2)	14564.00	(5)
(216-B-42)	Minimum			25.60		4310.00		6590.00	
	Maximum			10.40		5470.00		19900.00	
2-E33-18	Average (#)	NN		9.38	(2)	5195.00	(2)	17066.67	(3)
(216-B-7A,7B)	Minimum			8.35		4920.00		13700.00	
	Maximum			167.00		5230.00		52300.00	
2-E33-1A	Average (#)	NN		130.70	(2)	4865.00	(2)	38428.00	(5)
(216-B-43)	Minimum			94.40		4500.00		6640.00	
	Maximum			15.10		5070.00		4430.00	
2-E33-20	Average (#)	NN		10.13	(4)	5025.00	(2)	3662.50	(4)
(216-B-7,11)	Minimum			5.91		4980.00		2730.00	
	Maximum			25.80		2280.00		3500.00	
2-E33-21	Average (#)	NN		19.35	(4)	2180.00	(2)	3310.00	(3)
(216-B-36)	Minimum			13.30		2080.00		3140.00	
	Maximum			272.00		16100.00		13500.00	
2-E33-24	Average (#)	NN		258.00	(2)	14750.00	(2)	12200.00	(3)
(216-B-57)	Minimum			244.00		13400.00		11300.00	
	Maximum			233.00					
2-E33-26	Average (#)	NN		233.00	(2)	NN		NN	
(216-B-61)	Minimum			233.00					

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 6 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum		522.00	5230.00	60800.00
2-E33-3	Average (#)	NN	298.85 (2)	3900.00 (2)	48920.00 (5)
(216-B-45)	Minimum		75.70	2570.00	40700.00
	Maximum		245.00	5040.00	33700.00
2-E33-5	Average (#)	NN	236.50 (2)	4975.00 (2)	31720.00 (5)
(216-B-47)	Minimum		228.00	4910.00	30200.00
	Maximum		723.00	10900.00	119000.00
2-E33-7	Average (#)	NN	594.75 (4)	9335.00 (2)	111000.00 (2)
(216-B-49)	Minimum		361.00	7770.00	103000.00
	Maximum		69.00	4990.00	7780.00
2-E33-8	Average (#)	NN	62.30 (2)	4035.00 (2)	7730.00 (3)
(216-B-41)	Minimum		55.60	3080.00	7700.00
	Maximum		174.00	4580.00	8730.00
2-E33-9	Average (#)	NN	159.00 (3)	4026.67 (3)	7996.67 (3)
(241-BY)	Minimum		140.00	3450.00	7300.00
	Maximum	1.87	9.05	1900.00	13400.00
2-E34-1	Average (#)	1.68 (4)	8.13 (4)	1640.00 (4)	12700.00 (2)
(216-B-63)	Minimum	1.55	5.89	1460.00	12000.00
	Maximum		49.30	54800.00	550000.00
2-W10-1	Average (#)	NN	40.22 (4)	54250.00 (2)	503000.00 (2)
(216-T-5)	Minimum		32.10	53700.00	456000.00
	Maximum	12.90	92.90	118000.00	926000.00
2-W10-3	Average (#)	11.06 (4)	60.00 (4)	112500.00 (2)	793500.00 (2)
(216-T-32)	Minimum	9.25	28.70	107000.00	661000.00
	Maximum		79.90	88500.00	222000.00
2-W10-4	Average (#)	NN	67.00 (2)	82400.00 (2)	209800.00 (5)
(216-T-36)	Minimum		54.10	76300.00	194000.00
	Maximum	1.41	6.30	3240.00	58900.00
2-W10-8	Average (#)	0.97 (2)	4.55 (2)	2985.00 (2)	31273.33 (3)
(241-T)	Minimum	0.53	2.79	2730.00	2720.00
	Maximum	3.93	49.40	65000.00	426000.00
2-W10-9	Average (#)	3.06 (2)	47.40 (2)	62000.00 (2)	387250.00 (4)
(241-T)	Minimum	2.19	45.40	59000.00	356000.00
	Maximum	3.16	54.40		
2-W11-11	Average (#)	2.63 (2)	53.80 (2)	NN	NN
(216-T-18)	Minimum	2.09	53.20		

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 7 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)		Tritium (pCi/L)		Nitrate (p/b)	
	Maximum	273.00		193.00				125000.00	
2-W11-14	Average (#)	256.50	(4)	146.98	(4)	NN		120500.00	(2)
(216-T-33)	Minimum	233.00		97.90				116000.00	
	Maximum			22.90					
2-W11-15	Average (#)	NN		20.20	(3)	NN		NN	
(216-T-32)	Minimum			18.00					
	Maximum			70.10					
2-W11-18	Average (#)	NN		67.40	(2)	NN		NN	
(216-T-35)	Minimum			64.70					
	Maximum	1.29		13.30				757000.00	
2-W11-23	Average (#)	1.18	(2)	11.90	(2)	NN		435000.00	(2)
(241-T)	Minimum	1.06		10.50				113000.00	
	Maximum	0.66		8.90				163000.00	
2-W11-24	Average (#)	0.44	(2)	7.45	(2)	NN		155500.00	(2)
(241-T)	Minimum	0.23		5.99				148000.00	
	Maximum	1.73		66.00				215000.00	
2-W11-7	Average (#)	1.34	(4)	58.03	(4)	NN		209000.00	(2)
(216-T-3)	Minimum	0.87		52.00				203000.00	
	Maximum	5.76		8.88		1700.00		101000.00	
2-W14-10	Average (#)	5.51	(2)	7.33	(2)	1395.00	(2)	89266.67	(3)
(216-W-LWC)	Minimum	5.25		5.78		1090.00		82500.00	
	Maximum	1.16		54.40		80300.00		74500.00	
2-W14-2	Average (#)	0.94	(2)	44.45	(2)	65750.00	(2)	61180.00	(5)
(216-T-26)	Minimum	0.71		34.50		51200.00		51400.00	
	Maximum			39.90		6280.00		290000.00	
2-W14-5	Average (#)	NN		32.75	(2)	4030.00	(2)	107780.00	(5)
(241-TX)	Minimum			25.60		1780.00		41400.00	
	Maximum	2.45		40.60		11400.00		55500.00	
2-W14-6	Average (#)	1.59	(2)	19.38	(5)	8352.50	(4)	29300.00	(7)
(241-TX)	Minimum	0.72		10.10		5560.00		14900.00	
	Maximum	1.03		14.00		7110.00		114000.00	
2-W15-10	Average (#)	0.90	(2)	13.35	(2)	5975.00	(2)	89175.00	(4)
(216-Z-16)	Minimum	0.78		12.70		4840.00		66000.00	
	Maximum	1.64		16.30		18100.00		131000.00	
2-W15-11	Average (#)	1.36	(2)	15.65	(2)	16400.00	(2)	113000.00	(4)
(216-Z-16)	Minimum	1.08		15.00		14700.00		95000.00	

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 8 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	0.79	6.82	1190.00	4320.00
2-W15-2	Average (#)	0.51 (3)	5.14 (3)	646.50 (2)	3985.00 (2)
(218-W-4A)	Minimum	0.34	3.41	103.00	3650.00
	Maximum	1.69	128.00		140000.00
2-W15-3	Average (#)	1.38 (4)	102.13 (4)	NN	135500.00 (4)
(241-TY)	Minimum	1.02	89.00		132000.00
	Maximum		10.10	202000.00	699000.00
2-W15-4	Average (#)	NN	9.34 (2)	178500.00 (2)	539250.00 (4)
(216-T-19)	Minimum		8.57	155000.00	397000.00
	Maximum	1.43	4.50		9320.00
2-W15-6	Average (#)	1.08 (4)	4.17 (4)	NN	8000.00 (4)
(216-Z-9)	Minimum	0.69	3.68		5900.00
	Maximum	0.48	20.30	2040.00	60000.00
2-W15-7	Average (#)	0.47 (2)	20.00 (2)	1508.00 (2)	56675.00 (4)
(216-Z-7)	Minimum	0.46	19.70	976.00	54800.00
	Maximum	0.10	38.20		139000.00
2-W15-8	Average (#)	-0.04 (4)	28.03 (4)	NN	139000.00 (1)
(216-Z-9)	Minimum	-0.11	18.80		139000.00
	Maximum	49.20	16.60	484.00	2500.00
2-W18-15	Average (#)	42.90 (4)	13.23 (4)	223.75 (4)	1948.33 (6)
(216-U-10)	Minimum	32.50	9.22	101.00	1200.00
	Maximum	0.79	4.59	102.00	4680.00
2-W18-17	Average (#)	0.13 (11)	3.04 (11)	33.57 (3)	2536.00 (5)*
(216-Z-20)	Minimum	-0.20	1.69	-97.90	500.00
	Maximum	2.41	4.18	521.00	2500.00
2-W18-20	Average (#)	1.07 (8)	3.26 (8)	201.67 (3)	2500.00 (3)
(216-Z-20)	Minimum	0.17	0.70	-58.00	2500.00
	Maximum	1.14	8.13		277000.00
2-W18-5	Average (#)	1.08 (2)	7.54 (2)	NN	263666.67 (3)
(216-Z-12)	Minimum	1.02	6.95		255000.00
	Maximum	0.48	7.45		
2-W18-7	Average (#)	0.25 (4)	5.13 (4)	NN	NN
(216-Z-1A)	Minimum	0.11	3.16		
	Maximum	0.32	4.72		6060.00
2-W18-9	Average (#)	0.18 (4)	3.37 (4)	NN	3900.00 (5)
(216-Z-18)	Minimum	-0.14	1.20		2500.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 9 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	2570.00	3160.00	680.00	93100.00
2-W19-11	Average (#)	2323.33 (3)	2780.00 (3)	680.00 (1)	88900.00 (3)
(216-U-1,2)	Minimum	1930.00	2560.00	680.00	86200.00
	Maximum	2.99	337.00	310.00	11100.00
2-W19-12	Average (#)	2.88 (2)	222.50 (2)	296.00 (2)	9100.00 (2)
(241-U)	Minimum	2.77	108.00	282.00	7100.00
	Maximum	8.48	18.70	593.00	21000.00
2-W19-13	Average (#)	7.41 (4)	16.55 (4)	223.25 (4)	18900.00 (5)
(216-U-16)	Minimum	6.00	14.80	53.70	17000.00
	Maximum	4.37	11.50	212.00	10400.00
2-W19-14	Average (#)	3.58 (4)	9.02 (4)	154.00 (4)	8122.50 (4)
(216-U-16)	Minimum	2.39	6.32	114.00	3540.00
	Maximum	235.00	325.00	1080.00	107000.00
2-W19-15	Average (#)	138.98 (4)	264.50 (4)	1011.75 (3)	85580.00 (5)
(216-U-1,2)	Minimum	49.30	207.00	947.00	70300.00
	Maximum	989.00	1540.00	591.00	50900.00
2-W19-16	Average (#)	768.00 (4)	1257.50 (4)	362.25 (4)	45700.00 (4)
(216-U-1,2)	Minimum	461.00	1090.00	124.00	39100.00
	Maximum	36.10	63.60	373.00	9870.00
2-W19-17	Average (#)	24.23 (3)	51.70 (3)	192.27 (3)	9743.33 (3)
(216-U-1,2)	Minimum	17.10	45.70	25.80	9660.00
	Maximum	3710.00	6180.00	3860.00	146000.00
2-W19-18	Average (#)	2600.00 (12)	4260.83 (12)	1709.50 (4)	117500.00 (13)
(216-U-1,2)	Minimum	1930.00	3300.00	854.00	94100.00
	Maximum	594.00	1750.00	1910.00	1450000.00
2-W19-19	Average (#)	525.85 (13)	1121.69 (13)	1617.69 (13)	1330833.33 (12)
(216-U-17)	Minimum	453.00	533.00	1060.00	1220000.00
	Maximum	114.00	163.00	75100.00	340000.00
2-W19-2	Average (#)	94.97 (12)	133.25 (12)	62925.00 (4)	267750.00 (12)
(216-U-8)	Minimum	75.10	111.00	51100.00	222000.00
	Maximum	391.00	2610.00	3130.00	1110000.00
2-W19-20	Average (#)	361.25 (12)	1418.33 (12)	1819.17 (10)	996846.15 (13)
(216-U-17)	Minimum	313.00	1100.00	1350.00	827000.00
	Maximum	16.10	8.73	115.00	2500.00
2-W19-21	Average (#)	14.83 (3)	8.61 (3)	64.10 (3)	1025.00 (4)
(216-U-14)	Minimum	13.40	8.42	-18.40	500.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 10 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	208.00	386.00	1130.00	487000.00
2-W19-23	Average (#)	155.18 (11)	340.36 (11)	763.18 (11)	412818.18 (11)
(216-U-17)	Minimum	126.00	300.00	456.00	346000.00
	Maximum	469.00	3430.00	2550.00	1270000.00
2-W19-24	Average (#)	382.18 (11)	2643.64 (11)	1916.64 (11)	1067461.54 (13)
(216-U-17)	Minimum	299.00	1870.00	943.00	854000.00
	Maximum	285.00	5110.00	2110.00	841000.00
2-W19-25	Average (#)	220.90 (10)	3890.00 (10)	1732.00 (10)	760200.00 (10)
(216-U-17)	Minimum	154.00	2820.00	1350.00	588000.00
	Maximum	305.00	799.00	1520.00	1280000.00
2-W19-26	Average (#)	246.57 (7)	522.14 (7)	1213.43 (7)	1105714.29 (7)
(216-U-17)	Minimum	189.00	318.00	424.00	850000.00
	Maximum	9.77	13.60	227.00	2580.00
2-W19-27	Average (#)	8.19 (4)	9.66 (4)	141.88 (3)	2526.67 (3)
(216-U-14)	Minimum	7.04	7.30	64.50	2500.00
	Maximum	3100.00	2870.00	817.00	60300.00
2-W19-3	Average (#)	2180.00 (13)	2081.54 (13)	521.83 (6)	46053.85 (13)
(216-U-1,2)	Minimum	1610.00	700.00	383.00	36900.00
	Maximum		27.30	826.00	4220.00
2-W19-5	Average (#)	NN	22.60 (2)	597.50 (2)	2812.50 (4)
(216-S-23)	Minimum		17.90	369.00	2100.00
	Maximum	1360.00	1100.00	562.00	34400.00
2-W19-9	Average (#)	894.20 (5)	781.60 (5)	252.65 (4)	20450.00 (6)
(216-U-1,2)	Minimum	613.00	353.00	60.00	16200.00
	Maximum	5.78	30.80	1900.00	12400.00
2-W22-1	Average (#)	4.79 (3)	29.60 (3)	1257.33 (3)	6330.00 (5)
(216-S-1,2)	Minimum	3.96	27.90	792.00	3830.00
	Maximum	0.47	64.80	121000.00	
2-W22-10	Average (#)	0.20 (4)	48.68 (4)	107350.00 (2)	NN
(216-S-1,2)	Minimum	-0.09	32.80	93700.00	
	Maximum		7.44	25200.00	2770.00
2-W22-12	Average (#)	NN	6.31 (2)	22650.00 (2)	2487.50 (4)
(216-S-7)	Minimum		5.17	20100.00	2280.00
	Maximum	1.24	14.30		
2-W22-18	Average (#)	1.13 (4)	13.38 (4)	NN	NN
(216-S-8)	Minimum	1.02	12.40		

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 11 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)		Tritium (pCi/L)		Nitrate (p/b)	
	Maximum	6.17		21.70		14900.00		6500.00	
2-W22-2	Average (#)	5.47	(4)	19.78	(4)	10475.00	(4)	5287.50	(4)
(216-S-1,2)	Minimum	4.93		16.70		6700.00		3910.00	
	Maximum			32.40		200000.00		199000.00	
2-W22-20	Average (#)	NN		31.45	(2)	196500.00	(2)	143400.00	(5)
(216-S-20)	Minimum			30.50		193000.00		122000.00	
	Maximum	13.60		170.00				35300.00	
2-W22-21	Average (#)	12.60	(2)	167.00	(2)	NN		24000.00	(2)
(216-S-13)	Minimum	11.60		164.00				12700.00	
	Maximum	6.36		5.84		1810.00		15800.00	
2-W22-22	Average (#)	2.25	(4)	4.75	(4)	1150.75	(4)	10287.50	(4)
(216-U-12)	Minimum	0.68		3.41		-127.00		2810.00	
	Maximum			23.30		132000.00		18700.00	
2-W22-26	Average (#)	NN		21.05	(2)	109250.00	(2)	15000.00	(4)
(216-S-9)	Minimum			18.80		86500.00		12800.00	
	Maximum			24.80		435.00		3290.00	
2-W23-1	Average (#)	NN		18.53	(4)	333.00	(2)	2752.50	(4)
(216-S-3)	Minimum			11.40		231.00		2500.00	
	Maximum	39.50		21.00		687000.00		147000.00	
2-W23-10	Average (#)	35.15	(4)	16.78	(4)	636000.00	(3)	115800.00	(5)
(216-S-25)	Minimum	31.70		11.70		579000.00		101000.00	
	Maximum	17.20		8.59		1240.00		2500.00	
2-W23-11	Average (#)	16.20	(4)	6.79	(4)	815.75	(4)	2500.00	(4)
(216-U-10)	Minimum	14.80		5.25		341.00		2500.00	
	Maximum			1180.00				30200.00	
2-W23-2	Average (#)	NN		721.82	(11)	NN		29325.00	(4)
(241-SX)	Minimum			216.00				27700.00	
	Maximum			131.00				19500.00	
2-W23-3	Average (#)	NN		106.28	(4)	NN		13502.50	(4)
(241-SX)	Minimum			65.40				8410.00	
	Maximum	59.90		59.90		5450000.00		9730.00	
2-W23-4	Average (#)	39.37	(7)	45.97	(7)	1689714.29	(7)	7460.00	(7)
(216-S-21)	Minimum	21.50		23.00		496000.00		5300.00	
	Maximum			1200.00					
2-W23-7	Average (#)	NN		479.91	(11)	NN		NN	
(241-SX)	Minimum			188.00					

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 12 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Nitrate (p/b)
	Maximum	26.40	16.60	1470000.00	105000.00
2-W23-9	Average (#)	20.14 (11)	12.89 (11)	1381818.18 (8)	90563.64 (11)
(216-S-25)	Minimum	17.50	10.10	1280000.00	24600.00
	Maximum	1.14	2.90	121.00	2500.00
2-W26-3	Average (#)	0.95 (2)	2.85 (2)	17.40 (2)	2500.00 (2)
(216-S-6)	Minimum	0.76	2.79	-86.20	2500.00
	Maximum	1.25	6.56	1450.00	3310.00
2-W26-6	Average (#)	1.10 (2)	6.11 (2)	700.80 (2)	2905.00 (2)
(216-S-5)	Minimum	0.95	5.65	-48.40	2500.00
	Maximum	13.00	9.71	5760.00	63500.00
2-W27-1	Average (#)	9.31 (4)	8.76 (4)	2164.75 (4)	47240.00 (5)
(216-S-26)	Minimum	5.24	7.65	267.00	29000.00
	Maximum	0.99	18.70	146000.00	9170.00
6-32-72	Average (#)	0.39 (4)	12.43 (4)	139000.00 (4)	7272.50 (4)
(216-S-19)	Minimum	-0.07	2.51	134000.00	2500.00
	Maximum		32.80	1180000.00	28500.00
6-35-70	Average (#)	NN	25.73 (4)	1083500.00 (4)	28150.00 (4)
(600-AREA)	Minimum		22.40	984000.00	27900.00
	Maximum	15.30	9.88	178.00	2500.00
6-35-78A	Average (#)	12.61 (4)	6.91 (4)	100.38 (4)	2036.75 (4)
(216-U-10)	Minimum	9.73	5.11	-13.50	647.00
	Maximum	52.20	437.00	1460.00	245000.00
6-38-70	Average (#)	40.82 (13)	357.15 (13)	1181.33 (3)	230200.00 (5)
(600-AREA)	Minimum	19.60	269.00	914.00	217000.00
	Maximum	0.74	4.78	426.00	2500.00
6-42-40A	Average (#)	0.38 (5)	3.74 (5)	34.40 (5)	1740.00 (5)
(216-B-3)	Minimum	0.16	2.12	-371.00	500.00
	Maximum	-0.45	121.00	2070.00	2500.00
6-42-40B	Average (#)	-0.45 (1)	13.80 (12)	342.02 (12)	2100.00 (5)
(216-B-3)	Minimum	-0.45	2.89	-38.70	500.00
	Maximum	2.62	7.25	52300.00	8860.00
6-45-42	Average (#)	1.64 (13)	4.77 (13)	48700.00 (11)	6643.08 (13)
(216-B-3)	Minimum	0.43	3.18	45600.00	5170.00
	Maximum	1.52	8.27	4410.00	13300.00
6-50-42	Average (#)	0.91 (4)	6.67 (4)	3885.00 (4)	5725.00 (4)
(216-A-25)	Minimum	0.21	5.78	2490.00	2500.00

Table B-1. Results for Screening Parameters in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 13 of 13)

Well (Waste Site)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)		Tritium (pCi/L)		Nitrate (p/b)	
	Maximum	3.94		142.00				5690.00	
6-53-47A	Average (#)	1.38	(11)	112.90	(11)	NN		5690.00	(1)
(216-A-25)	Minimum	-0.07		68.30				5690.00	
	Maximum	3.56		196.00					
6-53-47B	Average (#)	3.25	(4)	173.75	(4)	NN		NN	
(216-A-25)	Minimum	2.80		151.00					
	Maximum	9.49		149.00					
6-53-48A	Average (#)	2.28	(4)	65.22	(4)	NN		NN	
(216-A-25)	Minimum	-0.25		29.30					
	Maximum	0.25		857.00					
6-53-48B	Average (#)	-0.02	(4)	597.50	(4)	NN		NN	
(216-A-25)	Minimum	-0.17		447.00					
	Maximum	1.47		10.20					
6-53-55A	Average (#)	1.31	(2)	9.63	(2)	NN		NN	
(216-A-25)	Minimum	1.14		9.06					
	Maximum	1.73		106.00					
6-54-48	Average (#)	1.40	(4)	95.47	(4)	NN		NN	
(216-A-25)	Minimum	0.82		81.30					
	Maximum	1.35		59.60					
6-54-49	Average (#)	0.88	(4)	53.85	(4)	NN		NN	
(216-A-25)	Minimum	0.25		42.60					
	Maximum	1.33		7.10		229.00		2600.00	
6-55-50C	Average (#)	1.06	(5)	5.34	(5)	45.75	(4)	2134.00	(5)
(216-A-25)	Minimum	0.65		3.93		-276.00		1530.00	
	Maximum	2.67		49.20		368.00		2500.00	
6-55-50D	Average (#)	1.86	(4)	17.13	(4)	176.71	(4)	2500.00	(4)
(216-A-25)	Minimum	0.25		5.73		8.62		2500.00	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 1 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	4.17	0.96	3.69	7.97	-0.01	2.83	
2-E13-14	Average (#)	0.74 (2)	0.42 (2)	3.09 (2)	-1.72 (2)	-0.01 (1)	2.58 (2)	NN
(216-B-29)	Minimum	-2.68	-0.13	2.48	-11.40	-0.01	2.32	
	Maximum	1.14	0.69	1.15	33.90	0.01	4.31	
2-E13-19	Average (#)	-1.93 (2)	0.40 (2)	0.01 (2)	16.95 (2)	0.01 (1)	1.63 (2)	NN
(216-B-28)	Minimum	-5.00	0.11	-1.14	0.00	0.01	-1.06	
	Maximum	0.18	3.90	67.70	-29.40		4.77	
2-E13-5	Average (#)	-3.28 (2)	2.06 (2)	33.89 (2)	-45.55 (2)	NN	4.04 (2)	NN
(216-B-18)	Minimum	-6.74	0.22	0.07	-61.70		3.31	
	Maximum	0.21	0.47	2.82	40.80	1.30	2.63	
2-E13-8	Average (#)	-1.82 (4)	0.42 (2)	2.28 (2)	9.82 (4)	1.30 (1)	-0.30 (4)	NN
(216-B-21)	Minimum	-6.27	0.37	1.73	-28.20	1.30	-2.61	
	Maximum	7.09	0.35		31.80	0.21	5.65	
2-E16-2	Average (#)	1.45 (12)	0.10 (4)	NN	-1.23 (12)	0.21 (1)	-0.68 (12)	NN
(216-A-30)	Minimum	-4.25	-0.17		-38.20	0.21	-9.77	
	Maximum	-5.27	6.34		-23.40		-1.94	
2-E17-1	Average (#)	-5.27 (1)	6.34 (1)	NN	-23.40 (1)	NN	-1.94 (1)	NN
(216-A-10)	Minimum	-5.27	6.34		-23.40		-1.94	
	Maximum	12.40	0.44	755.00	90.60	2.57	9.13	3.94
2-E17-12	Average (#)	4.17 (12)	-0.14 (12)	448.50 (2)	25.69 (12)	2.40 (2)	-0.08 (12)	3.13 (12)
(216-A-45)	Minimum	-5.57	-0.37	142.00	-23.40	2.23	-5.93	2.19
	Maximum	19.00	3.01	84.70	116.00	2.11	4.89	4.79
2-E17-13	Average (#)	6.46 (13)	0.37 (12)	84.70 (1)	51.91 (13)	1.81 (2)	0.99 (13)	3.42 (12)
(216-A-45)	Minimum	-3.96	-0.41	84.70	-22.20	1.51	-2.74	2.03

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 2 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	17.60	3.11		235.00	1.18	0.66	5.98
2-E17-2	Average (#)	14.18 (4)	2.69 (4)	NN	116.13 (4)	1.18 (1)	-0.95 (4)	4.46 (4)
(216-A-27)	Minimum	8.82	2.23		39.40	1.18	-2.12	3.36
	Maximum	51.10	4.38	312.00	399.00	15.60	3.77	6.35
2-E17-5	Average (#)	32.51 (13)	3.84 (5)	312.00 (1)	261.47 (13)	10.84 (3)	-1.18 (13)	5.38 (12)
(216-A-36B)	Minimum	-2.84	3.35	312.00	6.36	3.21	-9.19	3.12
	Maximum	-0.78	0.58	-0.50	22.30	0.00	2.53	
2-E17-6	Average (#)	-0.78 (1)	0.37 (3)	-0.50 (1)	22.30 (1)	-0.12 (2)	2.53 (1)	NN
(216-A-36B)	Minimum	-0.78	-0.03	-0.50	22.30	-0.23	2.53	
	Maximum	3.56	2.77		25.30		5.59	
2-E17-8	Average (#)	-1.80 (4)	2.27 (4)	NN	-2.03 (4)	NN	3.72 (4)	NN
(216-A-10)	Minimum	-4.55	1.32		-37.50		2.61	
	Maximum	4.46	3.57	126.00	35.10	20.40	4.10	2.68
2-E17-9	Average (#)	1.32 (6)	2.51 (3)	126.00 (1)	11.82 (6)	20.40 (1)	0.90 (6)	2.28 (5)
(216-A-36B)	Minimum	-0.61	1.93	126.00	-14.10	20.40	-5.96	1.32
	Maximum	4.55	14.30		18.00	26.60	2.65	
2-E24-1	Average (#)	-0.18 (4)	13.45 (2)	NN	3.46 (4)	26.60 (1)	-0.53 (4)	NN
(216-A-5)	Minimum	-5.70	12.60		-8.45	26.60	-2.98	
	Maximum	1.70	1.66		50.70		3.54	
2-E24-11	Average (#)	0.63 (4)	1.09 (4)	NN	11.76 (4)	NN	-1.40 (4)	NN
(216-A-10)	Minimum	-1.83	0.86		-31.40		-7.10	
	Maximum	9.26	4.29		547.00	1.91	-1.12	
2-E24-12	Average (#)	4.89 (8)	3.45 (4)	NN	236.88 (8)	1.91 (1)	-4.49 (8)	NN
(216-A-21,31)	Minimum	-0.21	2.04		-1.94	1.91	-9.05	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 3 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	-0.38	0.68		71.80	2.56	1.41	
2-E24-13	Average (#)	-2.82 (2)	0.34 (2)	NN	26.65 (2)	2.56 (1)	-0.67 (2)	NN
(241-A)	Minimum	-5.27	-0.01		-18.50	2.56	-2.74	
	Maximum	6.88	3.33		28.40		1.86	
2-E24-2	Average (#)	3.48 (4)	2.88 (4)	NN	-5.27 (4)	NN	0.10 (4)	NN
(216-A-10)	Minimum	-0.76	2.48		-47.60		-2.12	
	Maximum	5.67	0.47		32.60		2.12	
2-E24-4	Average (#)	1.36 (4)	0.09 (2)	NN	4.42 (4)	NN	0.31 (4)	NN
(216-A-9)	Minimum	-2.08	-0.30		-15.70		-1.49	
	Maximum	2.83	0.40	32.90	30.70		5.22	
2-E24-8	Average (#)	0.36 (4)	0.11 (2)	24.30 (2)	-4.13 (4)	NN	0.89 (4)	NN
(216-C-3,4,5)	Minimum	-2.85	-0.18	15.70	-34.50		-2.25	
	Maximum	2.02			23.70		0.74	1.39
2-E25-10	Average (#)	-1.35 (2)	NN	NN	15.84 (2)	NN	-0.58 (2)	1.23 (2)
(216-A-19)	Minimum	-4.71			7.97		-1.91	1.07
	Maximum	7.30	0.20		59.70	0.29	3.35	
2-E25-11	Average (#)	1.52 (12)	0.03 (4)	NN	5.02 (12)	0.29 (1)	-0.45 (12)	NN
(216-A-30)	Minimum	-2.85	-0.16		-81.60	0.29	-3.76	
	Maximum	10.20	0.33		26.30		0.00	
2-E25-17	Average (#)	1.37 (4)	0.18 (4)	NN	4.87 (4)	NN	-0.49 (4)	NN
(216-A-37-1)	Minimum	-2.02	-0.03		-8.94		-1.13	
	Maximum	-2.82	0.46	2.11	61.90		0.35	
2-E25-18	Average (#)	-3.26 (4)	0.01 (4)	2.11 (1)	34.13 (4)	NN	-1.66 (4)	NN
(216-A-37-1)	Minimum	-4.17	-0.41	2.11	10.60		-5.65	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 4 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	5.65	0.30		20.50	0.44	2.39	
2-E25-19	Average (#)	2.28 (4)	0.13 (4)	NN	8.34 (4)	0.44 (1)	-0.77 (4)	NN
(216-A-37-1)	Minimum	-5.73	-0.24		-0.89	0.44	-2.97	
	Maximum	-0.76	0.51		0.99		5.42	
2-E25-2	Average (#)	-2.36 (2)	0.15 (2)	NN	0.50 (2)	NN	3.24 (2)	NN
(216-A-1,7)	Minimum	-3.97	-0.20		0.00		1.06	
	Maximum	3.03	0.80		37.20		2.23	
2-E25-20	Average (#)	-1.01 (4)	0.25 (4)	NN	18.20 (4)	NN	-0.85 (4)	NN
(216-A-37-1)	Minimum	-4.17	-0.15		3.18		-4.47	
	Maximum	3.52	0.23		16.80		3.01	
2-E25-21	Average (#)	-0.62 (4)	0.01 (4)	NN	-15.28 (4)	NN	1.45 (4)	NN
(216-A-37-2)	Minimum	-6.06	-0.24		-33.00		0.75	
	Maximum	7.93	0.61	1.33	43.80	0.43	-1.41	
2-E25-22	Average (#)	3.35 (6)	-0.03 (4)	1.33 (1)	6.89 (6)	0.43 (1)	-2.82 (6)	NN
(216-A-37-2)	Minimum	0.75	-0.58	1.33	-26.60	0.43	-6.01	
	Maximum	1.01	0.31		23.30	0.05	3.35	
2-E25-23	Average (#)	-0.86 (4)	-0.19 (4)	NN	3.68 (4)	0.05 (1)	0.39 (4)	NN
(216-A-37-2)	Minimum	-2.23	-0.39		-12.60	0.05	-3.38	
	Maximum	7.04	0.72		56.00	0.04	4.24	
2-E25-24	Average (#)	0.30 (4)	-0.07 (4)	NN	11.47 (4)	0.04 (1)	-1.46 (4)	NN
(216-A-37-2)	Minimum	-5.59	-0.58		-15.00	0.04	-4.21	
	Maximum		0.50			1.17		
2-E25-3	Average (#)	NN	0.46 (2)	NN	NN	1.17 (1)	NN	NN
(216-A-6)	Minimum		0.43			1.17		

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 5 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	5.06	0.22		36.60		1.13	
2-E25-6	Average (#)	-1.15 (4)	0.06 (4)	NN	11.45 (4)	NN	-2.67 (4)	NN
(216-A-8)	Minimum	-4.04	-0.17		-25.60		-4.97	
	Maximum	5.26	0.82		40.70	0.96	4.64	0.72
2-E25-9	Average (#)	1.31 (4)	0.06 (4)	NN	-8.46 (4)	0.96 (1)	-1.07 (4)	0.54 (4)
(216-A-8)	Minimum	-0.56	-0.33		-43.90	0.96	-9.19	0.40
	Maximum		0.12			1.25		
2-E26-2	Average (#)	NN	-0.06 (2)	NN	NN	1.25 (1)	NN	NN
(216-A-24)	Minimum		-0.23			1.25		
	Maximum		0.90			1.37		
2-E26-4	Average (#)	NN	0.55 (2)	NN	NN	1.37 (1)	NN	NN
(216-A-24)	Minimum		0.20			1.37		
	Maximum	-0.38	0.06		1.79		3.64	
2-E26-6	Average (#)	-2.72 (4)	-0.10 (4)	NN	-14.93 (4)	NN	1.78 (4)	NN
(401-A COOL)	Minimum	-7.30	-0.28		-44.50		-1.48	
	Maximum	3.04	0.62	101.00	-41.80	1.53	-0.11	
2-E27-5	Average (#)	-1.99 (2)	0.32 (2)	70.00 (2)	-49.20 (2)	1.53 (1)	-0.23 (2)	NN
(216-C-10)	Minimum	-7.01	0.01	39.00	-56.60	1.53	-0.35	
	Maximum	3.65			50.30		4.84	13.72
2-E28-12	Average (#)	-1.06 (12)	NN	NN	2.75 (12)	NN	0.50 (12)	13.72 (1)
(216-B-55)	Minimum	-7.53			-60.50		-3.42	13.72
	Maximum	4.93			51.20		3.64	2.34
2-E28-13	Average (#)	0.65 (4)	NN	NN	23.97 (4)	NN	-0.34 (4)	2.34 (1)
(216-B-55)	Minimum	-2.67			2.78		-6.01	2.34

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 6 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum							7.47
2-E28-16	Average (#)	NN	NN	NN	NN	NN	NN	6.86 (2)
(216-B-12)	Minimum							6.26
	Maximum							8.42
2-E28-17	Average (#)	NN	NN	NN	NN	NN	NN	6.74 (4)
(216-B-6,10)	Minimum							5.43
	Maximum	6.42	0.04		36.20		3.50	39.72
2-E28-18	Average (#)	0.84 (12)	-0.13 (4)	NN	-3.41 (12)	NN	-0.77 (12)	27.52 (12)
(216-B-62)	Minimum	-5.30	-0.31		-53.40		-7.78	6.15
	Maximum							10.39
2-E28-19	Average (#)	NN	NN	NN	NN	NN	NN	7.60 (4)
(216-B-62)	Minimum							4.43
	Maximum	7.46	0.38		44.00		4.36	32.05
2-E28-21	Average (#)	-0.13 (12)	0.05 (4)	NN	14.24 (12)	NN	1.23 (12)	25.64 (12)
(216-B-62)	Minimum	-9.72	-0.13		-63.50		-2.47	16.70
	Maximum	228.00	6150.00	142.00	571.00		1800.00	18.74
2-E28-23	Average (#)	71.08 (4)	4610.00 (4)	121.50 (2)	205.29 (4)	NN	1480.00 (4)	16.67 (4)
(216-B-5)	Minimum	6.53	3120.00	101.00	7.17		1230.00	13.92
	Maximum	5.53	192.00		15.70		5.30	0.30
2-E28-24	Average (#)	2.41 (4)	168.50 (4)	NN	-9.43 (4)	NN	1.92 (4)	0.19 (4)
(216-B-5)	Minimum	-0.61	146.00		-22.60		-1.88	0.12
	Maximum	7.57	6270.00		17.80		90.10	13.31
2-E28-25	Average (#)	1.95 (4)	5237.50 (4)	NN	-1.05 (4)	NN	60.80 (4)	8.71 (4)
(216-B-5)	Minimum	-2.82	4530.00		-20.20		34.70	5.20

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 7 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	9.63	105.00	136.00	-0.89	1.26	23.30	1.15
2-E28-7	Average (#)	0.73 (4)	67.95 (4)	107.95 (2)	-22.22 (4)	1.26 (1)	5.92 (4)	0.89 (4)
(216-B-5)	Minimum	-11.20	46.00	79.90	-46.90	1.26	-0.85	0.48
	Maximum							6.17
2-E28-9	Average (#)	NN	NN	NN	NN	NN	NN	5.31 (4)
(216-B-12)	Minimum							2.93
	Maximum	6.83	0.42		62.90		8.27	
2-E33-10	Average (#)	4.23 (2)	0.23 (2)	NN	34.65 (2)	NN	2.65 (2)	NN
(216-B-42)	Minimum	1.62	0.04		6.39		-2.98	
	Maximum	1.42	-0.03	32.30	33.60	0.95	-2.71	
2-E33-18	Average (#)	-0.62 (2)	-0.19 (2)	26.75 (2)	0.90 (2)	0.95 (1)	-3.24 (2)	NN
(216-B-7A,7B)	Minimum	-2.65	-0.34	21.20	-31.80	0.95	-3.76	
	Maximum	3.31	0.04	880.00	0.00	0.70	3.89	
2-E33-1A	Average (#)	0.80 (2)	-0.05 (2)	752.50 (2)	-9.40 (2)	0.70 (1)	1.76 (2)	NN
(216-B-43)	Minimum	-1.71	-0.15	625.00	-18.80	0.70	-0.37	
	Maximum		2.62	34.10		0.69		
2-E33-20	Average (#)	NN	1.93 (2)	32.15 (2)	NN	0.69 (1)	NN	NN
(216-B-7,11)	Minimum		1.24	30.20		0.69		
	Maximum	8.28	-0.29	110.00	31.30	1.38	0.00	
2-E33-21	Average (#)	0.41 (4)	-0.66 (2)	83.85 (2)	-9.13 (4)	1.38 (1)	-2.27 (4)	NN
(216-B-36)	Minimum	-9.98	-1.02	57.70	-35.20	1.38	-5.76	
	Maximum	9.30	0.35	1550.00	24.20	0.99	-3.76	
2-E33-24	Average (#)	5.97 (2)	-0.07 (2)	1490.00 (2)	-2.10 (2)	0.99 (1)	-5.06 (2)	NN
(216-B-57)	Minimum	2.63	-0.49	1430.00	-28.40	0.99	-6.36	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 8 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	13.10	-0.15		23.10		1.94	
2-E33-26	Average (#)	12.20 (2)	-0.23 (2)	NN	-7.10 (2)	NN	0.17 (2)	NN
(216-B-61)	Minimum	11.30	-0.30		-37.30		-1.59	
	Maximum	34.70	0.21		41.40		2.61	
2-E33-3	Average (#)	21.29 (2)	0.13 (2)	NN	-27.75 (2)	NN	-2.79 (2)	NN
(216-B-45)	Minimum	7.88	0.04		-96.90		-8.19	
	Maximum	14.00	0.16	1610.00	-5.40	0.84	1.06	
2-E33-5	Average (#)	13.60 (2)	0.01 (2)	1545.00 (2)	-15.95 (2)	0.84 (1)	0.27 (2)	NN
(216-B-47)	Minimum	13.20	-0.14	1480.00	-26.50	0.84	-0.53	
	Maximum	70.70	2.61	4420.00	3.13	0.37	6.33	
2-E33-7	Average (#)	53.45 (4)	1.09 (4)	4025.00 (2)	-21.27 (4)	0.37 (1)	2.58 (4)	NN
(216-B-49)	Minimum	26.40	0.06	3630.00	-34.50	0.37	0.63	
	Maximum	3.01	-0.01	399.00	-0.97	1.48	2.83	
2-E33-8	Average (#)	1.88 (2)	-0.02 (2)	343.00 (2)	-12.58 (2)	1.48 (1)	0.50 (2)	NN
(216-B-41)	Minimum	0.76	-0.03	287.00	-24.20	1.48	-1.83	
	Maximum	-0.17	1.14		9.63		7.64	
2-E33-9	Average (#)	-1.51 (3)	0.91 (3)	NN	-13.01 (3)	NN	4.34 (3)	NN
(241-BY)	Minimum	-2.85	0.68		-57.00		1.99	
	Maximum	-1.52			37.00		2.47	
2-E34-1	Average (#)	-2.30 (4)	NN	NN	8.93 (4)	NN	-1.17 (4)	NN
(216-B-63)	Minimum	-4.13			-18.00		-3.30	
	Maximum	9.48	0.34	514.00	33.10	0.01	3.40	
2-W10-1	Average (#)	3.80 (4)	0.27 (4)	507.00 (2)	1.26 (4)	0.01 (1)	1.08 (4)	NN
(216-T-5)	Minimum	-5.53	0.22	500.00	-36.40	0.01	-1.41	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 9 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	9.04	0.86		32.10	0.17	3.39	
2-W10-3	Average (#)	5.32 (4)	0.30 (4)	NN	-0.85 (4)	0.17 (1)	1.18 (4)	NN
(216-T-32)	Minimum	2.03	-0.32		-28.10	0.17	-1.71	
	Maximum	6.43	0.54		25.10	-0.03	1.33	
2-W10-4	Average (#)	2.24 (2)	0.24 (2)	NN	-3.10 (2)	-0.03 (1)	-2.48 (2)	NN
(216-T-36)	Minimum	-1.96	-0.05		-31.30	-0.03	-6.29	
	Maximum	2.53	0.11		16.60	-0.02	3.09	
2-W10-8	Average (#)	1.71 (2)	-0.11 (2)	NN	2.45 (2)	-0.02 (1)	1.12 (2)	NN
(241-T)	Minimum	0.89	-0.33		-11.70	-0.02	-0.85	
	Maximum	9.12	-0.04		25.10	0.03	2.24	
2-W10-9	Average (#)	6.69 (2)	-0.14 (2)	NN	-0.20 (2)	0.03 (1)	-0.37 (2)	NN
(241-T)	Minimum	4.27	-0.24		-25.50	0.03	-2.98	
	Maximum	6.50	0.03		12.80		1.12	
2-W11-11	Average (#)	5.94 (2)	-0.07 (2)	NN	12.65 (2)	NN	0.56 (2)	NN
(216-T-18)	Minimum	5.38	-0.16		12.50		0.00	
	Maximum	8.09	0.13	558.00	12.60		2.88	
2-W11-18	Average (#)	5.06 (2)	0.05 (2)	286.70 (2)	-14.50 (2)	NN	1.25 (2)	NN
(216-T-35)	Minimum	2.02	-0.02	15.40	-41.60		-0.37	
	Maximum	2.07	0.47		-3.20		2.26	
2-W11-23	Average (#)	0.33 (2)	-0.08 (2)	NN	-18.50 (2)	NN	1.30 (2)	NN
(241-T)	Minimum	-1.42	-0.62		-33.80		0.34	
	Maximum	3.94	0.03		9.55		2.51	
2-W11-24	Average (#)	0.56 (2)	-0.15 (2)	NN	-14.53 (2)	NN	1.44 (2)	NN
(241-T)	Minimum	-2.82	-0.33		-38.60		0.37	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 10 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	6.79	0.34		10.80		6.01	
2-W14-10	Average (#)	4.21 (2)	0.24 (2)	NN	8.60 (2)	NN	0.72 (2)	NN
(216-W-LWC)	Minimum	1.62	0.14		6.40		-4.57	
	Maximum	5.49	1.18	351.00	19.80		2.71	
2-W14-2	Average (#)	4.09 (2)	0.78 (2)	299.00 (2)	-0.05 (2)	NN	2.68 (2)	NN
(216-T-26)	Minimum	2.68	0.39	247.00	-19.90		2.65	
	Maximum	-1.89	-0.24		-14.90		2.63	
2-W14-5	Average (#)	-7.55 (2)	-0.28 (2)	NN	-28.25 (2)	NN	1.97 (2)	NN
(241-TX)	Minimum	-13.20	-0.32		-41.60		1.30	
	Maximum	-1.01	-0.06		34.80		-0.11	
2-W14-6	Average (#)	-1.77 (2)	-0.21 (2)	NN	11.55 (2)	NN	-1.01 (2)	NN
(241-TX)	Minimum	-2.53	-0.37		-11.70		-1.91	
	Maximum					0.02		
2-W15-10	Average (#)	NN	NN	NN	NN	0.02 (1)	NN	NN
(216-Z-16)	Minimum					0.02		
	Maximum	-0.38	-0.12		4.97	-0.01	5.07	
2-W15-11	Average (#)	-0.57 (2)	-0.32 (2)	NN	-3.37 (2)	-0.01 (1)	3.39 (2)	NN
(216-Z-16)	Minimum	-0.76	-0.52		-11.70	-0.01	1.71	
	Maximum	6.28			12.60	0.03	4.89	
2-W15-2	Average (#)	3.33 (2)	NN	NN	-14.85 (2)	0.03 (1)	3.68 (2)	NN
(218-W-4A)	Minimum	0.38			-42.30	0.03	2.47	
	Maximum	3.02	0.17		47.30		-0.34	
2-W15-3	Average (#)	-2.24 (2)	0.09 (2)	NN	-3.25 (2)	NN	-1.11 (2)	NN
(241-TY)	Minimum	-7.50	0.02		-53.80		-1.88	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 11 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum		0.30	49.20				
2-W15-4	Average (#)	NN	0.10 (2)	47.60 (2)	NN	NN	NN	NN
(216-T-19)	Minimum		-0.11	46.00				
	Maximum			-0.15				
2-W15-6	Average (#)	NN	NN	-0.20 (2)	NN	NN	NN	NN
(216-Z-9)	Minimum			-0.25				
	Maximum	14.00	0.20		-13.90	0.10	7.89	
2-W15-7	Average (#)	13.50 (2)	0.14 (2)	NN	-18.10 (2)	0.10 (1)	1.96 (2)	NN
(216-Z-7)	Minimum	13.00	0.07		-22.30	0.10	-3.97	
	Maximum	6.83			48.20		2.83	42.91
2-W18-15	Average (#)	4.05 (4)	NN	NN	32.78 (4)	NN	0.67 (4)	39.79 (4)
(216-U-10)	Minimum	-0.61			10.60		-2.32	37.89
	Maximum	-0.38			33.10		4.45	
2-W18-17	Average (#)	-3.46 (4)	NN	NN	13.14 (4)	NN	0.10 (4)	NN
(216-Z-20)	Minimum	-7.82			-4.01		-3.37	
	Maximum	0.20			16.00		-0.13	
2-W18-20	Average (#)	-1.84 (3)	NN	NN	11.63 (3)	NN	-1.66 (3)	NN
(216-Z-20)	Minimum	-4.28			6.28		-4.47	
	Maximum	7.48	0.69	2870.00	14.10		3.01	2661.68
2-W19-11	Average (#)	3.01 (3)	0.69 (1)	1768.33 (3)	0.07 (3)	NN	1.41 (3)	2202.22 (3)
(216-U-1,2)	Minimum	-0.53	0.69	355.00	-25.00		-0.99	1772.19
	Maximum	-1.04	0.35	2350.00	3.19		-4.95	2.54
2-W19-12	Average (#)	-2.60 (2)	0.32 (2)	1525.50 (2)	-3.32 (2)	NN	-5.09 (2)	2.40 (2)
(241-U)	Minimum	-4.15	0.29	701.00	-9.82		-5.22	2.26

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 12 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	9.91	0.16		15.70		4.16	6.99
2-W19-13	Average (#)	2.53 (4)	-0.05 (4)	NN	-14.28 (4)	NN	0.59 (4)	6.50 (4)
(216-U-16)	Minimum	-3.73	-0.20		-39.50		-2.65	6.07
	Maximum	0.94	0.05		3.84		0.75	3.12
2-W19-14	Average (#)	-0.82 (4)	0.01 (4)	NN	-3.97 (4)	NN	-1.96 (4)	2.62 (4)
(216-U-16)	Minimum	-4.45	-0.03		-12.60		-3.73	2.17
	Maximum	4.05	-0.27	1030.00	12.80	1.29	3.50	228.14
2-W19-15	Average (#)	1.78 (4)	-0.35 (2)	896.25 (4)	-13.03 (4)	1.29 (1)	0.26 (4)	123.07 (4)
(216-U-1,2)	Minimum	-1.84	-0.42	802.00	-29.60	1.29	-3.57	38.02
	Maximum	3.98	-0.30	1720.00	45.80	2.25	2.48	1045.66
2-W19-16	Average (#)	0.92 (4)	-0.32 (2)	1420.00 (3)*	-5.06 (4)	2.25 (1)	-0.15 (4)	756.86 (3)
(216-U-1,2)	Minimum	-1.34	-0.34	1040.00	-43.90	2.25	-3.48	471.23
	Maximum	3.19	-0.12	178.00	9.53		3.91	33.81
2-W19-17	Average (#)	1.68 (3)	-0.12 (1)	169.00 (3)	-2.10 (3)	NN	1.46 (3)	20.96 (3)
(216-U-1,2)	Minimum	-0.21	-0.12	161.00	-17.40		-0.56	13.65
	Maximum	77.80	2.15	9200.00	10.50		6.89	3911.04
2-W19-18	Average (#)	11.67 (12)	1.37 (2)	5495.83 (12)	-4.57 (12)	NN	0.57 (12)	2740.90 (12)
(216-U-1,2)	Minimum	-0.61	0.60	3680.00	-28.80		-6.86	1751.82
	Maximum	5.07	0.66	17400.00	42.00		3.01	497.71
2-W19-19	Average (#)	2.87 (5)	0.34 (4)	11880.00 (12)	21.15 (5)	NN	1.52 (5)	441.12 (12)
(216-U-17)	Minimum	0.19	-0.26	8530.00	6.04		-1.38	343.57
	Maximum	2.63	8.24		25.40		5.64	96.42
2-W19-2	Average (#)	0.69 (4)	5.73 (4)	NN	-3.14 (4)	NN	2.62 (4)	75.47 (12)
(216-U-8)	Minimum	-1.52	4.20		-28.30		-0.71	43.25

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 13 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	7.57	0.05	16800.00	-0.89		5.39	368.02
2-W19-20	Average (#)	1.99 (4)	-0.05 (4)	12708.33 (12)	-18.72 (4)	NN	1.34 (4)	321.11 (12)
(216-U-17)	Minimum	-2.02	-0.13	10600.00	-52.30		-3.18	264.13
	Maximum	-0.95	0.39		25.70		0.12	15.68
2-W19-21	Average (#)	-2.18 (3)	0.20 (3)	NN	-6.20 (3)	NN	-0.75 (3)	13.38 (3)
(216-U-14)	Minimum	-4.64	-0.11		-30.10		-1.66	9.91
	Maximum	1.51	-0.28	1470.00	44.50		1.71	167.03
2-W19-23	Average (#)	-1.89 (4)	-0.40 (4)	1277.91 (11)	17.75 (4)	NN	-0.06 (4)	138.89 (11)
(216-U-17)	Minimum	-6.63	-0.56	907.00	-2.80		-1.49	106.60
	Maximum	4.31	1.92	37300.00	34.20		1.70	432.52
2-W19-24	Average (#)	2.22 (4)	1.51 (4)	26409.09 (11)	-7.23 (4)	NN	0.35 (4)	364.19 (11)
(216-U-17)	Minimum	0.81	1.01	20600.00	-47.40		-1.88	279.07
	Maximum	0.76	0.12	24500.00	42.40		3.64	264.81
2-W19-25	Average (#)	-0.52 (4)	-0.09 (4)	19230.00 (10)	8.34 (4)	NN	0.05 (4)	218.98 (10)
(216-U-17)	Minimum	-1.97	-0.26	14500.00	-11.30		-1.86	190.80
	Maximum	3.41	0.92	4260.00	41.50		4.89	261.42
2-W19-26	Average (#)	-0.17 (3)	0.28 (3)	2580.00 (7)	10.69 (3)	NN	1.51 (3)	210.49 (7)
(216-U-17)	Minimum	-6.09	-0.08	1040.00	-7.87		-1.12	175.18
	Maximum	5.18	0.25		50.00		2.98	9.44
2-W19-27	Average (#)	1.83 (4)	-0.07 (4)	NN	17.25 (4)	NN	0.03 (4)	7.46 (4)
(216-U-14)	Minimum	-0.53	-0.43		-55.20		-2.01	6.11
	Maximum	3.69	3.46	1280.00	17.60	15.50	6.14	3496.85
2-W19-3	Average (#)	0.55 (13)	1.53 (4)	1107.90 (10)	-7.11 (13)	15.50 (1)	1.12 (13)	2136.38 (11)
(216-U-1,2)	Minimum	-4.75	0.64	890.00	-31.40	15.50	-3.35	1622.81

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 14 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum			117.00				
2-W19-5	Average (#)	NN	NN	94.95 (2)	NN	NN	NN	NN
(216-S-23)	Minimum			72.90				
	Maximum	1.60	0.33	1020.00	30.90	1.54	0.33	1453.06
2-W19-9	Average (#)	0.18 (4)	0.09 (2)	491.75 (4)	8.04 (4)	1.54 (1)	-0.38 (4)	1045.66 (4)
(216-U-1,2)	Minimum	-2.16	-0.14	265.00	-20.30	1.54	-1.32	875.91
	Maximum	3.20	8.04		-4.49		3.88	
2-W22-1	Average (#)	0.57 (3)	7.81 (3)	NN	-25.93 (3)	NN	1.85 (3)	NN
(216-S-1,2)	Minimum	-3.38	7.44		-49.80		-0.74	
	Maximum	-0.57	25.70		42.30	-0.01	-0.35	
2-W22-10	Average (#)	-3.27 (4)	22.20 (4)	NN	3.73 (4)	-0.01 (1)	-1.80 (4)	NN
(216-S-1,2)	Minimum	-6.65	17.30		-30.00	-0.01	-3.73	
	Maximum	3.92	0.42		31.50		3.31	
2-W22-12	Average (#)	1.21 (2)	0.19 (2)	NN	20.40 (2)	NN	1.47 (2)	NN
(216-S-7)	Minimum	-1.50	-0.04		9.30		-0.37	
	Maximum	4.33	0.34	69.40	18.50		4.56	
2-W22-18	Average (#)	-0.33 (4)	-0.08 (4)	65.95 (2)	8.82 (4)	NN	0.69 (4)	NN
(216-S-8)	Minimum	-5.57	-0.41	62.50	-3.60		-2.05	
	Maximum	1.88	1.89		71.40		7.43	
2-W22-2	Average (#)	0.09 (4)	1.41 (4)	NN	18.54 (4)	NN	2.42 (4)	NN
(216-S-1,2)	Minimum	-1.71	1.13		-3.17		-1.88	
	Maximum	3.78	-0.04		5.90	0.34	4.53	
2-W22-20	Average (#)	0.36 (2)	-0.29 (2)	NN	-5.05 (2)	0.34 (1)	2.27 (2)	NN
(216-S-20)	Minimum	-3.07	-0.54		-16.00	0.34	0.00	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 15 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	-1.57	-0.03		-7.16		-4.84	
2-W22-21	Average (#)	-2.34 (2)	-0.22 (2)	NN	-25.33 (2)	NN	-6.21 (2)	NN
(216-S-13)	Minimum	-3.10	-0.41		-43.50		-7.58	
	Maximum	5.17	0.40		36.90		4.47	4.23
2-W22-22	Average (#)	2.30 (4)	0.09 (4)	NN	12.20 (4)	NN	0.86 (4)	1.56 (4)
(216-U-12)	Minimum	-0.36	-0.15		-3.04		-3.18	0.51
	Maximum	2.87	-0.07		-4.48		3.35	
2-W22-26	Average (#)	1.64 (2)	-0.20 (2)	NN	-18.09 (2)	NN	0.99 (2)	NN
(216-S-9)	Minimum	0.42	-0.32		-31.70		-1.38	
	Maximum	3.65	1.08		40.40	0.02	2.63	
2-W23-1	Average (#)	1.05 (4)	0.65 (2)	NN	11.11 (4)	0.02 (1)	-0.02 (4)	NN
(216-S-3)	Minimum	-1.03	0.22		-22.10	0.02	-1.60	
	Maximum	6.76	0.51	19.80	15.90		1.60	41.83
2-W23-10	Average (#)	2.24 (3)	0.17 (3)	12.25 (2)	-3.98 (3)	NN	0.02 (3)	36.17 (3)
(216-S-25)	Minimum	-2.07	-0.08	4.70	-18.30		-1.86	30.49
	Maximum	-0.41	-0.02	5.22	18.60		5.26	19.49
2-W23-11	Average (#)	-2.29 (4)	-0.21 (2)	2.82 (2)	-0.89 (4)	NN	1.69 (4)	14.29 (4)
(216-U-10)	Minimum	-4.05	-0.40	0.42	-19.00		-1.12	11.41
	Maximum	5.85	-0.15	4850.00	38.30		2.86	
2-W23-2	Average (#)	2.22 (4)	-0.26 (4)	3082.73 (11)	16.48 (4)	NN	1.01 (4)	NN
(241-SX)	Minimum	-1.86	-0.33	1390.00	0.00		-1.38	
	Maximum	2.24	0.50		-11.80		3.54	
2-W23-3	Average (#)	0.18 (4)	0.07 (4)	NN	-37.68 (4)	NN	1.81 (4)	NN
(241-SX)	Minimum	-2.84	-0.20		-92.70		0.00	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 16 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum		-0.06			-0.01		56.90
2-W23-4	Average (#)	NN	-0.18 (2)	NN	NN	-0.01 (1)	NN	36.05 (7)
(216-S-21)	Minimum		-0.31			-0.01		17.86
	Maximum			7830.00				
2-W23-7	Average (#)	NN	NN	2234.55 (11)	NN	NN	NN	NN
(241-SX)	Minimum			1080.00				
	Maximum	5.87	0.21	81.20	51.70		5.63	19.83
2-W23-9	Average (#)	0.58 (11)	-0.07 (4)	53.35 (2)	10.99 (11)	NN	-0.05 (11)	17.80 (11)
(216-S-25)	Minimum	-4.98	-0.25	25.50	-25.70		-4.60	13.38
	Maximum	3.94	-0.24		15.30		1.44	
2-W26-6	Average (#)	1.19 (2)	-0.40 (2)	NN	-11.40 (2)	NN	-0.21 (2)	NN
(216-S-5)	Minimum	-1.57	-0.56		-38.10		-1.86	
	Maximum	2.08	0.88		19.30		1.77	9.51
2-W27-1	Average (#)	-0.22 (4)	0.17 (4)	NN	2.16 (4)	NN	-2.05 (4)	8.03 (4)
(216-S-26)	Minimum	-3.96	-0.15		-17.70		-3.42	6.04
	Maximum	4.86	0.27	58.30	33.20	0.04	4.13	
6-32-72	Average (#)	1.96 (4)	0.03 (4)	53.00 (2)	-5.63 (4)	0.04 (1)	0.60 (4)	NN
(216-S-19)	Minimum	-1.18	-0.27	47.70	-34.60	0.04	-3.18	
	Maximum		0.97	135.00		87.80		
6-35-70	Average (#)	NN	0.23 (4)	127.00 (2)	NN	50.40 (2)	NN	NN
(600-AREA)	Minimum		-0.13	119.00		13.00		
	Maximum	5.06			60.60		5.41	17.59
6-35-78A	Average (#)	1.30 (4)	NN	NN	6.94 (4)	NN	1.13 (4)	14.17 (4)
(216-U-10)	Minimum	-1.37			-41.80		-2.01	11.41

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 17 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum		-0.01	3710.00		1.42		45.56
6-38-70	Average (#)	NN	-0.06 (3)	3275.45 (11)	NN	1.42 (1)	NN	41.09 (11)
(600-AREA)	Minimum		-0.08	2380.00		1.42		38.36
	Maximum	1.42	0.31		2.79		4.30	0.57
6-42-40A	Average (#)	-1.63 (4)	0.15 (4)	NN	-18.56 (4)	NN	-0.77 (4)	0.50 (4)
(216-B-3)	Minimum	-4.08	-0.18		-50.80		-4.51	0.33
	Maximum	5.64	0.93		27.90		13.30	
6-42-40B	Average (#)	0.79 (11)	0.35 (4)	NN	7.95 (11)	NN	1.57 (11)	NN
(216-B-3)	Minimum	-6.24	-0.31		-53.90		-3.35	
	Maximum	4.34	0.41		29.20		6.14	1.91
6-45-42	Average (#)	-0.38 (12)	-0.03 (12)	NN	-8.13 (12)	NN	-0.53 (12)	1.48 (12)
(216-B-3)	Minimum	-6.92	-0.37		-56.60		-6.07	1.28
	Maximum		0.44			0.32		
6-50-42	Average (#)	NN	0.20 (4)	NN	NN	0.32 (1)	NN	NN
(216-A-25)	Minimum		-0.09			0.32		
	Maximum	5.91	77.10		38.10		6.01	
6-53-47A	Average (#)	1.02 (11)	57.00 (11)	NN	10.42 (11)	NN	2.15 (11)	NN
(216-A-25)	Minimum	-1.57	38.70		-21.00		-5.22	
	Maximum	5.49	99.70		6.31		4.13	
6-53-47B	Average (#)	1.23 (4)	91.77 (4)	NN	-12.97 (4)	NN	0.48 (4)	NN
(216-A-25)	Minimum	-3.04	85.50		-25.20		-1.77	
	Maximum	-0.76	54.40		50.70		6.01	
6-53-48A	Average (#)	-3.18 (4)	25.25 (4)	NN	7.40 (4)	NN	3.26 (4)	NN
(216-A-25)	Minimum	-5.08	10.10		-21.80		1.14	

Table B-2. Results for Radionuclides in Unconfined Aquifer Wells during Calendar Year 1988. (Sheet 18 of 18)

Well (Waste Site)		^{60}Co (pCi/L)	^{90}Sr (pCi/L)	^{99}Tc (pCi/L)	^{106}Ru (pCi/L)	^{129}I (pCi/L)	^{137}Cs (pCi/L)	Gross Uranium (pCi/L)
	Maximum	5.06	477.00		14.90		1.59	
6-53-48B	Average (#)	2.76 (4)	365.75 (4)	NN	-22.56 (4)	NN	-0.46 (4)	NN
(216-A-25)	Minimum	-0.20	276.00		-53.80		-1.89	
	Maximum	-0.19	0.51		-6.31	-0.05	5.64	
6-53-55A	Average (#)	-1.61 (2)	0.26 (2)	NN	-13.76 (2)	-0.05 (1)	2.93 (2)	NN
(216-A-25)	Minimum	-3.04	0.02		-21.20	-0.05	0.23	
	Maximum	0.16	51.00		48.30		-2.58	
6-54-48	Average (#)	-2.90 (4)	42.88 (4)	NN	23.80 (4)	NN	-3.50 (4)	NN
(216-A-25)	Minimum	-6.58	29.30		0.00		-5.51	
	Maximum		27.40					
6-54-49	Average (#)	NN	24.20 (4)	NN	NN	NN	NN	NN
(216-A-25)	Minimum		19.30					
	Maximum	1.78	0.08		50.70	0.03	4.84	
6-55-50C	Average (#)	-0.16 (4)	-0.17 (4)	NN	4.05 (4)	0.03 (1)	1.45 (4)	NN
(216-A-25)	Minimum	-2.64	-0.68		-33.60	0.03	-0.69	
	Maximum		0.35			0.07		
6-55-50D	Average (#)	NN	-0.01 (4)	NN	NN	0.07 (1)	NN	NN
(216-A-25)	Minimum		-0.36			0.07		

Table B-3. Results for Isotopic Uranium and Plutonium in the Unconfined Aquifer during Calendar Year 1988. (Sheet 1 of 3)

Well (Waste Site)		^{234}U (pCi/L)	^{235}U (pCi/L)	^{238}U (pCi/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)
	Maximum	1.93	0.13	1.83	0.00	0.02
2-E17-12	Average (#)	1.80 (12)	0.08 (12)	1.67 (12)	0.00 (12)	0.00 (12)
(216-A-45)	Minimum	1.58	0.05	1.33	-0.01	0.00
	Maximum	2.36	0.11	2.21	0.00	0.01
2-E17-13	Average (#)	2.02 (12)	0.07 (12)	1.87 (12)	0.00 (12)	0.00 (12)
(216-A-45)	Minimum	1.63	0.04	1.17	0.00	0.00
	Maximum	16.60	0.76	16.60		
2-E28-18	Average (#)	10.27 (2)	0.44 (2)	9.92 (2)	NN	NN
(216-B-62)	Minimum	3.94	0.13	3.23		
	Maximum	70.80	3.21	67.20		
2-E28-21	Average (#)	43.60 (2)	2.08 (2)	41.25 (2)	NN	NN
(216-B-62)	Minimum	16.40	0.94	15.30		
	Maximum	9.80	0.43	9.72	0.07	11.10
2-E28-23	Average (#)	9.15 (2)	0.42 (2)	9.19 (2)	0.05 (4)	9.77 (4)
(216-B-5)	Minimum	8.49	0.42	8.65	0.04	9.21
	Maximum	0.08	0.01	0.10	0.00	0.24
2-E28-24	Average (#)	0.07 (2)	0.00 (2)	0.09 (2)	0.00 (4)	0.15 (4)
(216-B-5)	Minimum	0.06	0.00	0.08	0.00	0.08
	Maximum	6.73	0.32	6.69	0.03	5.44
2-E28-25	Average (#)	6.04 (2)	0.28 (2)	5.93 (2)	0.02 (4)	3.89 (4)
(216-B-5)	Minimum	5.35	0.23	5.17	0.02	1.10
	Maximum	0.73	0.03	0.61	0.00	0.01
2-E28-7	Average (#)	0.64 (2)	0.03 (2)	0.52 (2)	0.00 (4)	0.00 (4)
(216-B-5)	Minimum	0.54	0.03	0.43	0.00	0.00
	Maximum	22.90	2.75	24.50	0.00	0.00
2-W18-15	Average (#)	22.20 (2)	1.77 (2)	23.40 (2)	0.00 (2)	0.00 (2)
(216-U-10)	Minimum	21.50	0.80	22.30	0.00	0.00
	Maximum	1360.00	102.00	1490.00		
2-W19-11	Average (#)	1360.00 (1)	102.00 (1)	1490.00 (1)	NN	NN
(216-U-1,2)	Minimum	1360.00	102.00	1490.00		
	Maximum	114.00	5.63	117.00		
2-W19-15	Average (#)	74.15 (2)	3.87 (2)	75.00 (2)	NN	NN
(216-U-1,2)	Minimum	34.30	2.10	33.00		
	Maximum	609.00	46.80	595.00		
2-W19-16	Average (#)	513.00 (2)	35.65 (2)	499.50 (2)	NN	NN
(216-U-1,2)	Minimum	417.00	24.50	404.00		

Table B-3. Results for Isotopic Uranium and Plutonium in the Unconfined Aquifer during Calendar Year 1988. (Sheet 2 of 3)

Well (Waste Site)		^{234}U (pCi/L)	^{235}U (pCi/L)	^{238}U (pCi/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)
	Maximum	18.30	0.89	17.90		
2-W19-17	Average (#)	18.30 (1)	0.89 (1)	17.90 (1)	NN	NN
(216-U-1,2)	Minimum	18.30	0.89	17.90		
	Maximum	1890.00	116.00	2040.00		
2-W19-18	Average (#)	1605.00 (2)	89.60 (2)	1730.00 (2)	NN	NN
(216-U-1,2)	Minimum	1320.00	63.20	1420.00		
	Maximum	250.00	19.30	254.00		
2-W19-19	Average (#)	235.50 (4)	15.00 (4)	241.25 (4)	NN	NN
(216-U-17)	Minimum	220.00	12.90	227.00		
	Maximum	178.00	13.40	183.00		
2-W19-20	Average (#)	159.25 (4)	9.35 (4)	166.50 (4)	NN	NN
(216-U-17)	Minimum	136.00	6.41	141.00		
	Maximum	7.51	0.34	7.79	0.00	0.00
2-W19-21	Average (#)	7.29 (3)	0.32 (3)	7.57 (3)	0.00 (3)	0.00 (3)
(216-U-14)	Minimum	7.00	0.28	7.28	0.00	0.00
	Maximum	82.60	5.92	83.60	0.00	0.01
2-W19-23	Average (#)	74.59 (11)	3.82 (11)	74.68 (11)	0.00 (4)	0.00 (4)
(216-U-17)	Minimum	67.50	1.92	64.40	0.00	0.00
	Maximum	217.00	13.80	223.00	0.00	0.01
2-W19-24	Average (#)	180.90 (11)	10.02 (11)	186.15 (11)	0.00 (4)	0.00 (4)
(216-U-17)	Minimum	85.90	3.71	88.60	0.00	0.00
	Maximum	134.00	8.05	138.00	0.00	0.00
2-W19-25	Average (#)	116.00 (10)	6.24 (10)	118.60 (10)	0.00 (4)	0.00 (4)
(216-U-17)	Minimum	106.00	3.67	110.00	0.00	-0.01
	Maximum	145.00	6.66	145.00	0.00	0.00
2-W19-26	Average (#)	111.09 (7)	5.18 (7)	111.20 (7)	0.00 (3)	0.00 (3)
(216-U-17)	Minimum	83.60	3.53	82.60	-0.01	0.00
	Maximum	4.41	0.96	5.70	0.00	0.00
2-W19-27	Average (#)	4.07 (4)	0.36 (4)	4.17 (4)	0.00 (4)	0.00 (4)
(216-U-14)	Minimum	3.66	0.15	3.41	0.00	0.00
	Maximum	1860.00	110.00	1910.00		
2-W19-3	Average (#)	1455.00 (2)	82.70 (2)	1500.00 (2)	NN	NN
(216-U-1,2)	Minimum	1050.00	55.40	1090.00		
	Maximum	903.00	131.00	1000.00		
2-W19-9	Average (#)	688.00 (2)	74.95 (2)	752.50 (2)	NN	NN
(216-U-1,2)	Minimum	473.00	18.90	505.00		

Table B-3. Results for Isotopic Uranium and Plutonium in the Unconfined Aquifer during Calendar Year 1988. (Sheet 3 of 3)

Well (Waste Site)		^{234}U (pCi/L)	^{235}U (pCi/L)	^{238}U (pCi/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)
	Maximum	22.30	0.95	22.80		
2-W23-10	Average (#)	20.30 (3)	0.75 (3)	20.87 (3)	NN	NN
(216-S-25)	Minimum	18.80	0.50	18.80		
	Maximum	8.29	0.49	8.66		
2-W23-11	Average (#)	7.82 (4)	0.32 (4)	7.85 (4)	NN	NN
(216-U-10)	Minimum	7.17	0.17	7.34		
	Maximum	21.70	1.44	22.20		
2-W23-4	Average (#)	19.75 (2)	1.27 (2)	20.15 (2)	NN	NN
(216-S-21)	Minimum	17.80	1.10	18.10		
	Maximum	11.80	0.56	11.70		
2-W23-9	Average (#)	10.20 (4)	0.46 (4)	10.56 (4)	NN	NN
(216-S-25)	Minimum	9.04	0.35	9.53		
	Maximum	5.09	0.26	4.63	0.00	0.00
2-W27-1	Average (#)	4.77 (4)	0.19 (4)	4.25 (4)	0.00 (4)	0.00 (4)
(216-S-26)	Minimum	4.46	0.15	3.76	0.00	0.00
	Maximum	9.42	0.46	9.68	-0.01	0.00
6-35-78A	Average (#)	7.60 (4)	0.40 (4)	7.70 (4)	-0.01 (1)	0.00 (1)
(216-U-10)	Minimum	6.28	0.34	6.15	-0.01	0.00
	Maximum	0.48	0.06	0.45	0.00	0.00
6-42-40A	Average (#)	0.36 (4)	0.03 (4)	0.30 (4)	0.00 (4)	0.00 (4)
(216-B-3)	Minimum	0.21	0.01	0.18	0.00	0.00
	Maximum	1.16	0.07	0.89	0.00	0.00
6-45-42	Average (#)	1.00 (12)	0.03 (12)	0.75 (12)	0.00 (12)	0.00 (12)
(216-B-3)	Minimum	0.85	0.01	0.53	-0.01	0.00

Table B-4. Results for Confined Aquifer Wells during Calendar Year 1988. (Sheet 1 of 2)

Well		Tritium (pCi/L)		Nitrate (ppb)	
	Maximum	1.08		2500.00	
2-E26-8	Average (#)	-143.46	(2)	2500.00	(2)
	Minimum	-288.00		2500.00	
	Maximum	640.00		2500.00	
2-E33-12	Average (#)	535.50	(2)	2500.00	(2)
	Minimum	431.00		2500.00	
	Maximum	2220.00		2500.00	
6-42-40C	Average (#)	1825.00	(2)	2500.00	(2)
	Minimum	1430.00		2500.00	
	Maximum	307.00		7420.00	
6-47-50	Average (#)	190.00	(3)	6243.33	(3)
	Minimum	95.00		4000.00	
	Maximum	170.00		2500.00	
6-49-55B	Average (#)	98.45	(2)	2500.00	(2)
	Minimum	26.90		2500.00	
	Maximum	25.80		2500.00	
6-50-45	Average (#)	-79.10	(2)	2500.00	(2)
	Minimum	-184.00		2500.00	
	Maximum	219.00		2500.00	
6-50-48B	Average (#)	149.90	(2)	2500.00	(2)
	Minimum	80.80		2500.00	
	Maximum	-9.70		2500.00	
6-51-46	Average (#)	-30.20	(2)	2500.00	(2)
	Minimum	-50.70		2500.00	
	Maximum	3010.00		2500.00	
6-52-46A	Average (#)	1679.50	(2)	2500.00	(2)
	Minimum	349.00		2500.00	
	Maximum	12.90		2500.00	
6-52-48	Average (#)	-98.05	(2)	2500.00	(2)
	Minimum	-209.00		2500.00	
	Maximum	119.00		2500.00	
6-53-50	Average (#)	17.50	(2)	2500.00	(2)
	Minimum	-84.00		2500.00	
	Maximum	445.00		2500.00	
6-54-57	Average (#)	267.15	(2)	2500.00	(2)
	Minimum	89.30		2500.00	

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Table B-4. Results for Confined Aquifer Wells during Calendar Year 1988. (Sheet 2 of 2)

Well		Tritium (pCi/L)		Nitrate (ppb)	
	Maximum	51.80		2500.00	
6-56-53	Average (#)	11.35	(2)	2500.00	(2)
	Minimum	-29.10		2500.00	

APPENDIX C

SAMPLE COLLECTION SCHEDULE FOR 1989

LIST OF TABLES

Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 1 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isotopic U	Isotopic Pu	Nitrate
2-E13-14	216-B-29	P		Q											
2-E13-19	216-B-28	B		Q											
2-E13-5	216-B-18	P		Q	Q										
2-E13-8	216-B-21	B		Q		Q			Q		Q				
2-E16-2	216-A-30	B	M	M	M	M	Q		M		M				M
2-E17-1	216-A-10	P	Q	Q	Q	Q	Q		Q	SA	Q				Q
2-E17-12	216-A-45	P	M	M	M	M	M		M	Q	M	M	M	M	M
2-E17-13	216-A-45	P	M	M	M	M	M		M	Q	M	M	M	M	M
2-E17-2	216-A-27	B	M	M	M	Q	Q		Q	SA	Q	Q			M
2-E17-5	216-A-36B	P	M	M	M	M	Q		M	SA	M	M			M
2-E17-6	216-A-36B	P		Q	Q					SA					Q
2-E17-8	216-A-10	P		Q	Q	Q	Q		Q		Q				Q
2-E17-9	216-A-36B	P	M	M	M	M	Q		M	SA	M	M			M
2-E24-1	216-A-5	B		M	M	Q	SA		Q		Q				M
2-E24-11	216-A-10	B		M	Q	Q	Q		Q		Q				Q
2-E24-12	216-A-21,31	P		M	M	M	Q		M	SA	M				M
2-E24-13	241-A	B		Q											Q
2-E24-2	216-A-10	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E24-4	216-A-9	P		Q	Q	Q	SA		Q		Q				Q
2-E24-8	216-C-3,4,5	P		Q	Q	Q			Q		Q				Q
2-E25-10	216-A-18,19,20	P	SA	SA		SA			SA		SA	SA			
2-E25-11	216-A-30	B	M	M	M	M	Q		M		M				M
2-E25-13	241-AX	B		Q											Q
2-E25-17	216-A-37-1	B	M	M	M	Q	Q		Q		Q				M
2-E25-18	216-A-37-1	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-19	216-A-37-1	B	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-2	216-A-1,7	B		SA	SA										SA
2-E25-20	216-A-37-1	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-21	216-A-37-2	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-22	216-A-37-2	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-23	216-A-37-2	P	Q	Q	Q	Q	Q		Q		Q				Q

P-Pump B-Bailer M-Monthly Q-Quarterly SA-Semiannually A-Annually

Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 2 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isoto- pic U	Isoto- pic Pu	Nitrate
2-E25-24	216-A-37-2	P	Q	Q	Q	Q	Q		Q		Q				Q
2-E25-3	216-A-6	B		Q											
2-E25-6	216-A-8	B	M	M	M	Q	Q		Q		Q				Q
2-E25-9	216-A-8	B	M	M	Q	Q	Q		Q		Q	Q			Q
2-E26-2	216-A-24	B		Q	Q										Q
2-E26-4	216-A-24	B		Q	Q										Q
2-E26-6	401-A COOLING	B	Q	Q	Q	Q	Q		Q		Q				Q
2-E26-8	RR Aquifer	B			SA										SA
2-E27-5	216-C-10	P		SA		SA			SA		SA				
2-E27-7	241-C	P	SA	SA											SA
2-E28-12	216-B-55	B		M	M	M			M		M				
2-E28-13	216-B-55	P		Q	Q	Q			Q		Q				
2-E28-16	216-B-12	P	SA	SA								SA			
2-E28-17	216-B-6,10B	B	Q									Q			
2-E28-18	216-B-62	P	M	M	M	M	Q		M		M	M	SA		M
2-E28-19	216-B-62	B	Q	Q								Q			
2-E28-21	216-B-62	P	M	M	M	M	Q		M		M	M	SA		M
2-E28-23	216-B-5	P	Q	Q	Q	Q	Q		Q		Q	Q	SA	Q	Q
2-E28-24	216-B-5	B	Q	Q		Q	Q		Q		Q	Q	SA	Q	
2-E28-25	216-B-5	B	Q	Q		Q	Q		Q		Q	Q	SA	Q	
2-E28-7	216-B-5	B	Q	Q		Q	Q		Q		Q	Q	SA	Q	
2-E28-9	216-B-12	B	Q	Q								Q			
2-E32-1	LLBG	P		SA	SA										SA
2-E33-10	216-B-35,42	P		SA	SA	SA	SA		SA		SA				SA
2-E33-12	RR Aquifer	B			SA										SA
2-E33-18	216-B-7A,7B	P		SA		SA	SA		SA		SA				
2-E33-1A	216-B-43	P		SA		SA	SA		SA		SA				
2-E33-20	216-B-7,11	B		Q			SA								Q
2-E33-21	216-B-36	P		Q		Q			Q		Q				
2-E33-24	216-B-57	P		SA		SA	SA	SA	SA		SA				
2-E33-26	216-B-61	P		SA		SA	SA		SA		SA				
2-E33-3	216-B-44,45,46	P		SA	SA	SA	SA		SA		SA				

P-Pump B-Bailer M-Monthly Q-Quarterly SA-Semiannually A-Annually

Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 3 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isoto- pic U	Isoto- pic Pu	Nitrate
2-E33-5	216-B-47	P		SA		SA	SA		SA		SA				
2-E33-7	216-B-48,49,50	B		Q		Q	Q		Q		Q				
2-E33-8	216-B-41	P		SA		SA	SA		SA		SA				
2-E33-9	241-BY	B		Q	Q	Q	Q		Q		Q				Q
2-E34-1	216-B-63	P	Q	Q	Q	Q			Q		Q				
2-W10-1	216-T-5	B		Q		Q	Q		Q		Q				
2-W10-3	216-T-32	B	Q	Q		Q	Q		Q		Q				
2-W10-4	216-T-36	P		SA		SA	SA		SA		SA				
2-W10-8	241-T	P	SA	SA		SA	SA		SA		SA				SA
2-W10-9	241-T	P	SA	SA		SA	SA		SA		SA				SA
2-W11-11	216-T-18	P	SA	SA		SA	SA		SA		SA				
2-W11-14	216-T-33	B	Q	Q											
2-W11-15	216-T-32	P		Q											
2-W11-18	216-T-35	P		SA		SA	SA		SA		SA				
2-W11-23	241-T	P	SA	SA		SA	SA		SA		SA				SA
2-W11-24	241-T	P	SA	SA		SA	SA		SA		SA				SA
2-W11-7	216-T-3	B	Q	Q											
2-W14-10	216-W-LWC	P	Q	Q	Q	Q	Q		Q		Q				Q
2-W14-2	216-T-26,27,28	P	SA	SA	SA	SA	SA		SA		SA				
2-W14-5	241-TX	P		SA	SA										SA
2-W14-6	241-TX	P		Q	Q										Q
2-W15-10	216-Z-16	P	SA	SA											SA
2-W15-11	216-Z-16	P	SA	SA		SA	SA		SA		SA				SA
2-W15-2	218-W-4A	B	Q	Q											
2-W15-3	241-TY	B	Q	Q		SA	SA		SA		SA				Q
2-W15-4	216-T-19	P		SA	SA										SA
2-W15-6	216-Z-9	P	Q	Q											Q
2-W15-7	216-Z-7	P	SA	SA		SA	SA		SA		SA				SA
2-W15-8	216-Z-9	B	Q	Q											
2-W18-15	216-U-10	P	Q	Q	Q	Q			Q		Q	Q	SA	SA	Q
2-W18-17	216-Z-20	B	M	M	Q	Q			Q		Q				Q
2-W18-20	216-Z-20	B	M	M	Q	Q			Q		Q				Q

P-Pump B-Bailer M-Monthly Q-Quarterly SA-Semiannually A-Annually

Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 4 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isoto- pic U	Isoto- pic Pu	Nitrate
2-W18-5	216-Z-12	P	SA	SA											
2-W18-7	216-Z-1A	B	Q	Q											
2-W18-9	216-Z-18	B	Q	Q											Q
2-W19-11	216-U-1,2	P	M	M	Q	M	Q	M	M		M	M	SA		M
2-W19-12	241-U	P	SA	SA	SA	SA	SA		SA		SA	SA			SA
2-W19-13	216-U-16	P	Q	Q	Q	Q	Q		Q		Q	Q			Q
2-W19-14	216-U-16	P	Q	Q	Q	Q	Q		Q		Q	Q			Q
2-W19-15	216-U-1,2	P	Q	Q	Q	Q	SA	Q	Q		Q	Q	SA		Q
2-W19-16	216-U-1,2	P	Q	Q	Q	Q	SA	Q	Q		Q	Q	SA		Q
2-W19-17	216-U-1,2	P	Q	Q	Q	Q	SA	Q	Q		Q	Q	SA		Q
2-W19-18	216-U-1,2	P	M	M	Q	M	SA	M	M		M	M	SA		M
2-W19-19	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	Q		M
2-W19-2	216-U-8	P	M	M	Q	Q	Q		Q		Q	M			M
2-W19-20	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	Q		M
2-W19-21	216-U-14	P	Q	Q	Q	Q	Q		Q		Q	Q	Q	Q	Q
2-W19-23	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	M	Q	M
2-W19-24	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	M	Q	M
2-W19-25	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	M	Q	M
2-W19-26	216-U-17	P	M	M	M	Q	Q	M	Q		Q	M	M	Q	M
2-W19-27	216-U-14	P	Q	Q	Q	Q	Q		Q		Q	Q	Q	Q	Q
2-W19-3	216-U-1,2	P	M	M	Q	M	Q	M	M		M	M	SA		M
2-W19-5	216-S-23	P		SA	SA										SA
2-W19-9	216-U-1,2	P	Q	Q	Q	Q	SA	Q	Q		Q	Q	SA		Q
2-W22-1	216-S-1,2	P	Q	Q	Q	Q	Q		Q		Q				Q
2-W22-10	216-S-1,2	B	Q	Q		Q	Q		Q		Q				
2-W22-12	216-S-7	P		SA	SA	SA	SA		SA		SA				SA
2-W22-18	216-S-8	B	Q	Q		Q	Q		Q		Q				
2-W22-2	216-S-1,2	P	Q	Q	Q	Q	Q		Q		Q				Q
2-W22-20	216-S-20	P		SA	SA	SA	SA		SA		SA				
2-W22-21	216-S-13	P	SA	SA		SA	SA		SA		SA				SA
2-W22-22	216-U-12	P	Q	Q	Q	Q	Q		Q		Q	Q			Q
2-W22-26	216-S-9	P		SA	SA	SA	SA		SA		SA				

P-Pump B-Bailer M-Monthly Q-Quarterly SA-Semiannually A-Annually

Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 5 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isotopic U	Isotopic Pu	Nitrate
2-W23-1	216-S-3	B		Q		Q	SA		Q		Q				Q
2-W23-10	216-S-25	P	Q	Q	Q	Q	Q		Q		Q	Q	Q		Q
2-W23-11	216-U-10	P	Q	Q	Q	Q			Q		Q	Q	Q		Q
2-W23-2	241-SX	B		M		Q	Q	M	Q		Q				Q
2-W23-3	241-SX	B		Q		Q	Q		Q		Q				Q
2-W23-4	216-S-21	B	M	M	M							M	SA		M
2-W23-7	241-S	B		M				M							
2-W23-9	216-S-25	B	M	M	M	M	Q		M		M	M	Q		M
2-W26-3	216-S-6	P	SA	SA	SA										SA
2-W26-6	216-S-5	P	SA	SA	SA	SA	SA		SA		SA				SA
2-W27-1	216-S-26	P	Q	Q	Q	Q	Q		Q		Q	Q	Q	Q	Q
6-32-72	216-S-19	P	Q	Q											
6-35-70	600-AREA									SA					
6-35-78A	216-U-10	P	Q	Q	Q	Q			Q		Q	Q	Q		Q
6-38-70	600-AREA	P	M	M				M				M			
6-42-40A	216-B-3	P	Q	Q	Q	Q	Q		Q		Q	Q	Q	Q	Q
6-42-40B	216-B-3	B		M	M	M	Q		M		M				Q
6-42-40C	RR Aquifer	B			SA										SA
6-45-42	216-B-3	P	M	M	M	M	M		M		M	M	M	M	M
6-47-50	RR Aquifer	B			SA										SA
6-49-100C	Yakima Gate	B	Q	Q	Q		Q			A					Q
6-49-55B	RR Aquifer	B			SA										SA
6-50-42	216-A-25	P	SA	SA			Q								
6-50-45	RR Aquifer	B			SA										SA
6-50-48B	RR Aquifer	B			SA										SA
6-51-46	RR Aquifer	B			SA										SA
6-52-46A	RR Aquifer	B			SA										SA
6-52-48	RR Aquifer	B			SA										SA
6-53-47A	216-A-25	P	M	M		M	M		M		M				
6-53-47B	216-A-25	P	Q	Q		Q	Q		Q		Q				
6-53-48A	216-A-25	P	Q	Q		Q	Q		Q		Q				
6-53-48B	216-A-25	P	Q	Q		Q	Q		Q		Q				

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Table C-1. Sample Collection Schedule for Operational Groundwater Monitoring for Calendar Year 1989. (Sheet 6 of 6)

Monitoring Well	Site Monitored	Pump/ Bail	Gross Alpha	Gross Beta	Tritium	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	Total Uranium	Isoto- pic U	Isoto- pic Pu	Nitrate
6-53-50	RR Aquifer	B			SA										SA
6-53-55A	216-A-25	P	SA	SA		SA	SA		SA		SA				
6-54-48	216-A-25	P	Q	Q		Q	Q		Q		Q				
6-54-49	216-A-25	P	Q	Q			Q								
6-54-57	RR Aquifer	B			SA										SA
6-55-50C	216-A-25	P	Q	Q			Q								
6-55-50D	216-A-25	B	Q	Q			Q								
6-56-53	RR Aquifer	B			SA										SA
6-59-58	216-A-25	P	SA	SA			SA								
6-63-58	216-A-25	P	SA	SA			SA								
6-S28-E0	Patrol Academy		Q	Q	Q		Q			A					Q

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